VOL. XXXII NEW YORK—THURSDAY, FEBRUARY 11, 1915—CHICAGO No. 6

The AUTOMOBILE

Engine Balance and Vibration

What Causes Vibration—Different Motor Types Compared from Vibration Viewpoint—Designing a Vibrationless Eight-Cylinder Motor

By A. Ludlow Clayden

VIBRATION would cause the engineer but little concern if the human frame were less susceptible to it, but the whole sensory system of man is designed to appreciate vibrations of the smallest character. Sight, sound and touch are all vibratory and even taste and smell may possibly be due to electrical waves that are vibrations of a less concrete kind. Thus it is not surprising that any change for the better in the smoothness of a motor is appreciated very quickly by the passengers in the car to which it belongs, and it is likely to be a long time before automobile makers can safely feel that the last word on vibration has been said.

Why Engines Vibrate

Reciprocating engines vibrate because the connecting-rods are only a little longer than the stroke, because parts of the shafts and bearings bend under the loads put upon them, and because the turning effort, in a gas or oil engine, fluctuates with each explosion. Mathematical analyses are apt to take only one or other of these things into account to the neglect of the rest, so much that has been written on the subject loses practical value. For instance the two-cylinder, 90-degree V engine is nearly ideal from the point of view of reciprocating balance, but it has an irregular torque; so the horizontally opposed two-cylinder motor which is inferior in mathematical balance is yet far pleasanter to sit behind.

Similarly, crankshaft deflections under load often spoil the balance of the six-cylinder motor that, theoretically, is almost perfect, and an engine that has no other faults in the balance line can be rendered most unpleasant by a lack of homogeneity in the iron of which the flywheel is composed. Care in design and accuracy in manufacture enter into the matter almost equally, neither being of much use without the other, but properly to understand the whole question we must consider mathematical balance first, though there is no need to go deeply into figures or formulas.

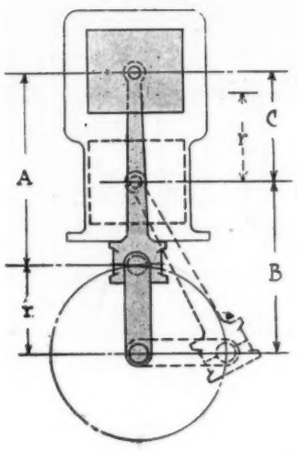
Reciprocating Balance

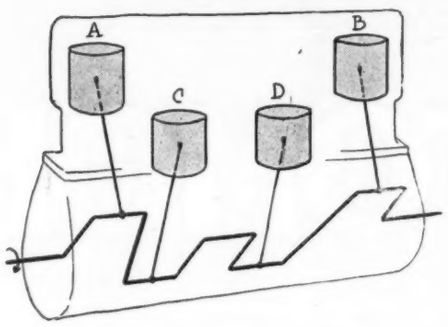
Fig. 1 shows a crank, connecting-rod, piston and cylinder in diagram. When the piston is at the top of its stroke the center of the wristpin is above the center of the crankpin by a distance equal to the length of the connecting-rod—A in Fig. 1. Now, imagine the position where the crankpin is half way round, at mid-stroke that is. Here the connecting-rod makes an angle with the vertical and the centers of wristpin and crankpin are thus no longer so far apart if we measure the *vertical* distance as B, Fig. 1. This means that the piston on the down stroke comes nearer to the center of the crankshaft faster than it would if the connecting-rod was not obliged to incline to the vertical. In other words the shorter the connecting-rod, the more it is tilted and the more the piston is accelerated by that tilting. A piston on the down stroke covers *more* than half its travel during the first *quarter* turn of the crank and *less* than half during the *second* quarter turn of the crank. On the upstroke it is easy to see that things are reversed, the third quarter turn of the crank causing less than half the piston travel in the upward direction, and the last quarter turn more than half the upward piston movement. This all means that the pistons on the commencement of the down stroke in a four-cylinder engine are moving faster than the other pair of pistons that are simultaneously on the upstroke.

Energy, Weight and Speed

Now the energy stored up in a moving mass depends upon its weight and speed, so in the four-cylinder engine we have equal weights of pistons and at mid-stroke they balance, but at any other points in the stroke where their speeds of movement are not the same, there is more energy stored in one pair than in the other. Follow the argument a little further. Looking at Fig. 2 suppose the right hand pair of pistons are on the first half of the down stroke, then it is they that are moving faster and the extra energy of motion is thus on the right side. After half stroke the left side pistons are moving faster than the right side pair and so the extra energy has shifted across to the other side too.

Since the pistons during the upper half of the crank circle move faster than in the lower half, a greater effort is required to arrest and reverse the direction of the piston at the top





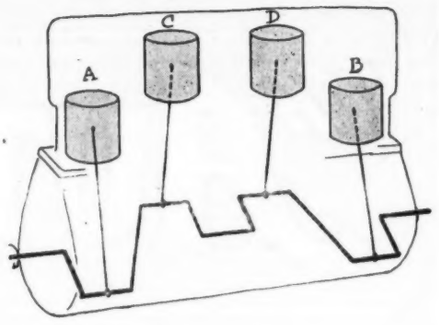


Fig. 1—Left—Piston moves more than half stroke during first quarter turn of crank. Since connecting rod is fixed length distance, B must be less than distance A, or C, the piston travel, is greater than r, the crank radius (half stroke) A + r = B + C, but B is less than A, so C is more than r. Fig. 2—Right—In left view upper pistons are on first half of down stroke, and so moving faster than lower pair of pistons that are on first half of upward stroke. In right hand view the rising pair are moving faster than the falling pair

dead center than at the bottom center. Now, as two pistons in a four-cylinder motor arrive at the top at the same instant as another two reach the bottom and, as the effort of stopping the top pair is greater than the effort of stopping the bottom pair it is obvious that there is some force left over, so to speak, and this will be an upward pull in the direction of the center line of the cylinders. Since each pair of pistons reach the top once in each revolution, this force appears twice each revolution and it is therefore called an unbalanced force of the *second* order of magnitude.*

There is another way of explaining the unbalanced force in a four-cylinder motor which will be useful later, and this is to imagine a common center of gravity for all the pistons together. We know that all bodies have a center of gravity, or a point where we can imagine all their weight to be concentrated. Turning to diagram Fig. 3, suppose that the weight of each piston is concentrated at one of the four black dots, then these four can be combined and represented by the single big black dot in the center. If we use graphical mechanics to find the position of this dot for a variety of piston positions, we shall find that it moves up and down the vertical center line of the engine as the crank revolves, making two oscillations for each turn of the shaft. Thus we can picture the unbalanced force as equal to the whole mass of all four pistons concentrated at the common center of gravity, and moving up and down a short distance very rapidly.

The effect of this unbalanced force in a four-cylinder engine is to lift the whole motor upwards twice each revolution, the weight and the fixing in the frame resisting the tendency.

*NOTE—Primary balance does not enter into the problem of simple multi-cylinder engines balancing, except in one case, and its nature will be touched upon in the proper place.

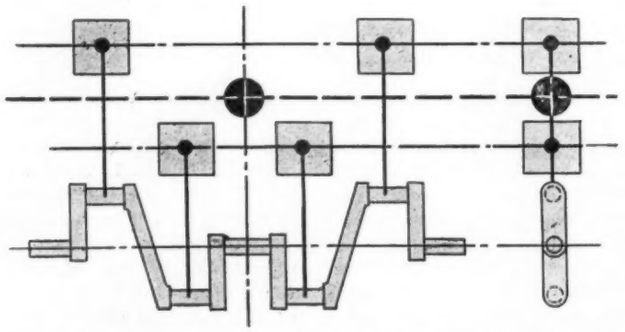


Fig. 3—Centers of gravity of each piston shown by small black dots act as though they had a common center of gravity indicated by large dot. The unbalanced force in a four-cylinder motor is measured by the total piston weight and by the amount of the slight distance the big black dot moves up and down during one crank revolution

Owing to the nature of the reciprocating engine there are often forces of higher orders that operate at various higher multiples of crankshaft speed, but any unbalanced forces above the second order of magnitude is usually so small as to be completely negligible in the small engines that are used on automobiles.

Eight-Cylinder Engine

An eight-cylinder V engine can be regarded as two blocks of four cylinders and the unbalanced forces will therefore tend to oscillate the motor as a whole along both the center line of the right block and that of the left block. Now, a mass cannot move in more than one direction at once, so the effect of the two separate unbalanced forces in the eight-cylinder motor is expressed by compounding them, and the resultant can be shown to be a separate force greater than either of the other two, but less than their sum; and oscillating transversely on a horizontal line drawn through the mass center of the motor. This is only true when the cylinders are at 90 degrees because they then make equal angles of 45 degrees with both the vertical and the horizontal. See Fig. 4. Other angles will produce an unbalanced force that tends to make the whole engine describe a small elliptical movement, the degree of the angle determining the relative depth and breadth of the ellipse. When the cylinders are at 60 degrees the "ellipse" is a circle.

Summing up therefore. The four-cylinder motor acts as though there was a small loose weight inside it vibrating up and down in a central vertical line.

The 90 degree eight acts as if a slightly heavier weight were vibrating it transversely.

The 60 degree eight acts as if a free weight was revolving round inside at twice the crankshaft speed.

The Six-Cylinder

It is less easy to explain the action of the forces in a six. It is perhaps most simple to imagine two pistons at the top of the stroke and therefore just undergoing reversal in direction of movement. Instead of these two being balanced by another pair at the bottom of the stroke, as in the four, they are balanced by *four* other pistons, two rising and two falling. These four pistons are none of them near a dead point, but are rather closer to the mid-stroke positions of maximum speed. Thus, instead of there being an instant when all the pistons are changing direction of motion together as they do in the four; when two are stationary another two are decelerating and yet another two are accelerating. The effect of removing the sudden change that is found in the four is to remove the unbalanced force altogether.

If we plot the common center of gravity of all the pistons, as shown in diagram Fig. 3, for the four-cylinder motor, we shall find—on trying different crank positions—that the common center of gravity does not move in any direction, and thus the six-cylinder motor is balanced completely.

Plunging Action

So far we have considered the balance of an engine solely from the end aspect, but if we regard the engine from the side there are other forces at work called couples. Take the diagram Fig. 5 which shows a four cylinder motor with the pistons at dead point. The outer pair are at the top and the inner pair at the bottom, so if we cut the engine in two by a vertical line and think of the forces acting on half the crank shaft we see then on each side there are two forces pulling upwards at the extreme right and left ends on the shaft, and there are two other forces pulling down near the middle of the shaft. If we forget the unbalanced force and suppose that an equal pull is needed to reverse the motion of a piston at the top and bottom of the stroke then we have four equal forces acting in the directions of the arrows A, B, C, D. Now this means that there is an attempt being made to pull the two halves of the shaft into the positions shown in Fig. 6, and when the pistons have made a half revolution the tendency is still to bend the shaft the same way, but the stresses on the bearings which prevent such whipping are now reversed in direction. In a two-cylinder engine this action produces a "couple" which tries to rock the whole motor and is damped out by the frame of the car, the springs and ultimately the wheels; its effect is to constantly throw a little extra weight first on the front and then on the rear axle.

In the four cylinder engine there are two of these couples in opposite directions so that they cancel out if the crank is stiff enough to resist the bending stress. This tendency to bend explains why the crankshaft of a two bearing pattern has to be so very stiff, since it gets no support at the point where bending is greatest, namely at the center.

A six-cylinder engine and a three-cylinder have equally good balance as viewed from the end, but there is a couple in the three-cylinder similar to that in the two. So the six-cylinder crank has to enable two opposing couples to counteract each other by reason of its intrinsic stiffness just as a four-cylinder crank has to do.

An Eight with Perfect Balance

The only objection that can seriously be urged against the eight as made at present is that it has a distinct unbalanced force, as has been shown already. There is a modification that is perfectly practical which would overcome this objection almost completely at a slight increase in cost of manufacture, and it seems curious that this has not been brought up during recent discussions on the subject. In the ordinary eight the unbalanced force acts along a horizontal line transverse to the motor and it is greater than the vertical unbalanced force in a four-cylinder engine. Both in the four and in the eight the unbalanced force is of the second order, that is to say it acts at twice crankshaft speed.

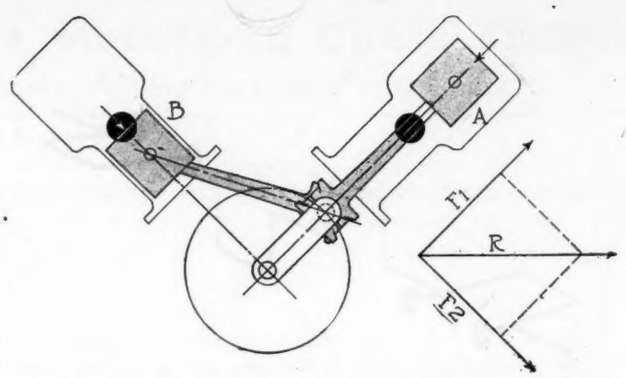


Fig. 4—A is at top of stroke, so force due to common mass of all pistons on right side is acting upward along center line of right cylinder block. B is at half stroke, so force due to four left pistons is acting down left center line. If F_1 F_2 in diagram of forces represent the unbalanced forces in amount and in direction, it is obvious that R is their resultant and acts horizontally

Now there are two ways of regarding the eight; we have adopted the scheme of considering two fours and showing that the resultant of their unbalanced forces produces the horizontal vibration aforesaid. We can, however, consider an eight as made up of four two-cylinder 90 degree motors, one behind the other, and if we adopt this plan the result appears differently although it is actually the same. The two-cylinder 90 degree V motor has an unbalanced force of the *first* order, that is at crankshaft speed, unless it is fitted with a balance weight as a counterpoise to the pistons. In a single cylinder motor it is impossible completely to overcome the primary unbalance by a single balance weight on the crank though it may be reduced greatly, but it is possible to reduce the magnitude of the force. In a 90 degree two-cylinder the primary force is completely balanced by fitting the crank with a suitable counterpoise, and when such an engine has the primary balance thereby rendered perfect there is left unbalanced only the secondary horizontal force which is just a quarter of the similar force in an eight with similar cylinder dimensions.

If instead of regarding the unbalance of the eight as made up of the sum of the two unbalanced forces of two four-cylinder motors we think of it as produced by each V-pair of cylinders considered separately, we have suggested to us the possibility of arranging these four forces so as to counteract each other. In the ordinary eight each of the

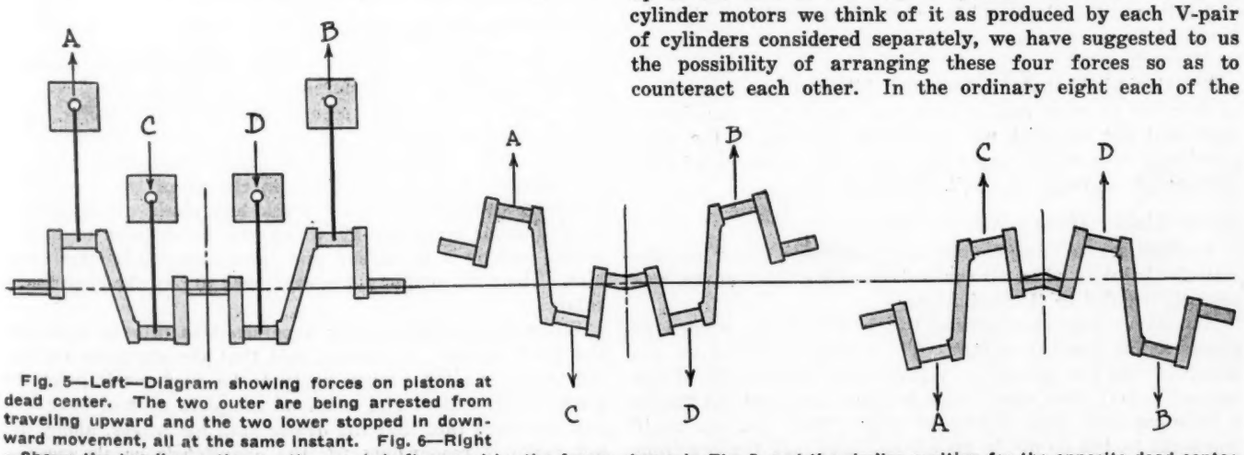


Fig. 5—Left—Diagram showing forces on pistons at dead center. The two outer are being arrested from traveling upward and the two lower stopped in downward movement, all at the same instant. Fig. 6—Right—Shows the bending action on the crankshaft caused by the forces shown in Fig. 5, and the similar position for the opposite dead center. Incidentaly explains the need for stiff crankshafts and for rigid center bearings

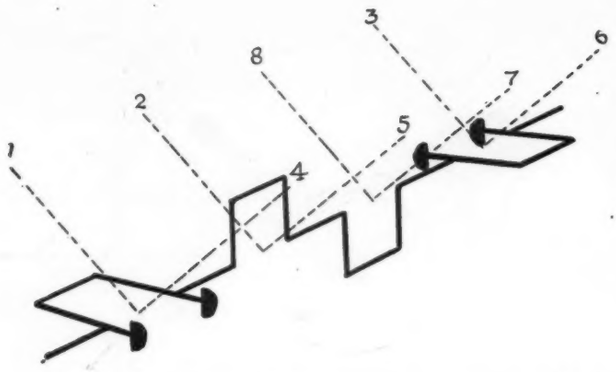


Fig. 7—With a shaft having the pairs of cranks at 90 degrees an eight-cylinder motor is in almost perfect balance, provided that a pair of balance masses are added. Of course, the firing order requires to be different, and the diagram shows a possible order which would give perfectly regular torque

four acts in the same direction as the other three at the same instant, but if we could make two cylinder pairs act one way while the other two acted in the opposite direction, the forces would neutralize each other.

Now, the secondary unbalanced force acts at twice the speed of crankshaft revolution, so if we are to balance the forces due to the four separate transverse pairs of cylinders we shall have to change the order of the cycle so as to retard two of the pairs by a time equal to *one quarter* of a crankshaft turn, since the unbalanced force reverses its direction completely during one *half* turn of the crank.

Take the first pair of cylinders, therefore, and it is easy to see that, if the unbalanced force due to them is to be balanced by that due to the second pair, their respective cranks must be at 90 degrees instead of 180 degrees as is usual. When this is done then the four cylinders forming the front half of the motor are balanced completely except for a transverse couple of small amount. Setting the rearmost pairs of cylinders similarly will balance them with respect to each other and will also cancel the couple, so leaving no unbalanced force at all of either first or second magnitude.

Actually there is a small unbalanced force acting at four times crankshaft speed, but this is only *one hundredth* of the force in an ordinary eight with all cranks in the same plane.

With such a motor as the one suggested the same even torque is obtainable by altering the sequence of firing. A possible order of firing is shown in Fig. 7.

The drawback to this type of motor being the balance masses necessary, it may be added that they have advantages on all types of engine for reasons that have nothing to do with the balance of reciprocating parts. Next week we shall consider vibration in the motor arising from causes other than the balance of the pistons and connecting-rods, and the matter of balanced cranks will be explained therein.

(*To be concluded*)

Recent Court Decisions—Pedestrian Loses

By George F. Kaiser

ALTHOUGH holding that all parts of a public highway are open to foot passengers and automobiles and that pedestrians are not obliged to look back, while the motorists are required to use every reasonable precaution to insure their safety, it was decided in California lately that a woman could not recover for her injuries when she rushed from a place of safety to one of danger, in terror at the sudden approach of an automobile.

The court held that a $2,000 judgment which she had received was improper, although women are liable to become panic stricken at the sudden approach of a car.—*Raymond vs. Hill*, 143 *Pacific* (*California*) 743.

Girl Not Negligent

That a young girl seven years old, crossing a street at a jog trot, was not guilty of negligence, if she was run down and injured at a place and hour where automobiles might be expected to move at a moderate speed, was recently decided in Massachusetts.

The Court held that, as the automobile was moving at from 15-20 miles an hour, and no horn was sounded, it was significant that the motorist was negligent, in view of the close proximity of a school house and the actual presence of children nearby.—*Trips vs. Taft*, 106 *N. E.* 578.

Owner Liable, Though Not in Car

Another severe case, holding an automobile owner responsible for injuries when his car is driven by a third party, was recently decided in Massachusetts.

A motorist was entertaining two men and two women as guests at his summer cottage. The women asked for an automobile ride but the owner refused and (the words of the learned court) they then "kept teasing" him and did "quite a little coaxing" until finally he said: "Well, you can go if you want to, but do not be gone long," and took the key from his pocket with which to unlock the switch and threw it down. One of the men guests had a chauffeur's license and knew how to operate the car. He took the women out and, through carelessness, injured another person who sued the owner.

The owner testified that he did not want them to go; that he knew his guest would drive and thought they would go just a little way and come back, but denied that the guest was acting as his agent in taking the women out.

The court held, however, that although if the defendant had merely loaned his car, or permitted it for use, in which he had no interest, he would not be liable; still, as the women were his guests, and he told them to return, the relation of host and guest existed during the ride and it must be presumed that the driver had implied authority to act as the owner's agent, and the owner must therefore stand responsible for the injuries caused by him.—*Campbell vs. Arnold*, 106 N. E. (*Massachusetts*), 599.

Owner Not Responsible

A motor truck owner was not responsible in damages merely because of its ownership of the truck.

In New York it was recently decided that a motor truck owner, having hired out its truck to another concern, was relieved from responsibility for injuries occurring through the negligence of the chauffeur in charge of the truck. The company owning the motor truck had made an agreement with another company by which the latter was to hire a truck, employ a chauffeur and have complete control over him. The first company, however, was to pay the chauffeur's salary.

While driving negligently a person was injured and sued the truck owner. The court said that the company renting the truck was the proper party to be sued, as it gave the chaffeur his orders and assumed complete control over him and the mere fact that the owner paid his wages, alone, did not make it responsible for the chauffeur's carelessness.—*Diamond vs. Sternberg*, 149 *N. Y. S.* (*New York*) 1,000.

Capacity of Eight-Cylinder Motors in Cubic Inches

Calculated for Bores Between $2\frac{1}{2}$ and 5 Inches, with Strokes from $2\frac{1}{2}$ to $6\frac{1}{2}$ Inches

BORE—INCHES

STROKE—INCHES	2 1-2	2 9-16	2 5-8	2 11-16	2 3-4	2 13-16	2 7-8	2 15-16	3	3 1-16	3 1-8	3 3-16	3 1-4	3 5-16	3 3-8	3 7-16	3 1-2	3 9-16	3 5-8	3 11-16	3 3-4
2 1-2	98.2	103.1	108.2	113.4	118.8	124.2	129.8	135.5													
2 5-8	103.1	108.3	113.6	119.1	124.7	130.4	136.3	142.3													
2 3-4	108.0	113.4	119.0	124.8	130.6	136.7	142.8	149.1													
2 7-8	112.9	118.6	124.5	130.4	136.6	142.9	149.3	155.9													
3	117.8	123.8	129.9	136.1	142.5	149.1	155.8	162.6	169.6	176.8	184.1	191.5	199.1	206.8	214.7	222.7	230.9				
3 1-8	122.7	128.9	135.3	141.8	148.5	155.3	162.3	169.4	176.7	184.1	191.7	199.5	207.4	215.4	223.6	232.0	240.5				
3 1-4	127.6	134.1	140.7	147.5	154.4	161.5	168.8	176.2	183.8	191.5	199.4	207.5	215.7	224.0	232.6	241.3	250.1				
3 3-8	132.5	139.2	146.1	153.1	160.3	167.7	175.3	183.0	190.8	198.9	207.2	215.4	224.0	232.7	241.5	250.6	259.7				
3 1-2	137.4	144.4	151.5	158.8	166.3	173.9	181.8	189.7	197.9	206.2	214.7	223.4	232.3	241.3	250.5	259.8	269.4	279.1	288.9	299.0	309.2
3 5-8	142.3	149.5	156.9	164.5	172.2	180.1	188.2	196.5	205.0	213.6	222.4	231.4	240.6	249.9	259.4	269.1	279.0	289.1	299.3	309.7	320.3
3 3-4	147.2	154.7	162.3	170.1	178.2	186.4	194.7	203.3	212.0	221.0	230.1	239.4	248.9	258.5	268.4	278.4	288.6	299.0	309.6	320.4	331.3
3 7-8	152.2	159.8	167.7	175.8	184.1	192.6	201.2	210.1	219.1	228.3	237.7	247.4	257.1	267.1	277.3	287.6	298.2	309.0	319.9	331.0	342.3
4	157.1	165.0	173.2	181.5	190.0	198.8	207.7	216.8	226.2	235.7	245.4	255.3	265.4	275.8	286.3	296.9	307.9	319.0	330.2	341.7	353.4
4 1-8	161.9	170.2	178.6	187.2	196.0	205.0	214.2	223.6	233.2	243.1	253.1	263.3	273.7	284.4	295.2	306.2	317.5	328.9	340.5	352.4	364.4
4 1-4	166.9	175.3	184.0	192.8	201.9	211.2	220.7	230.4	240.3	250.4	260.8	271.3	282.0	293.0	304.2	315.5	327.1	338.9	350.9	363.1	375.5
4 3-8	171.8	180.5	189.4	198.5	207.9	217.4	227.2	237.2	247.4	257.8	268.4	279.3	290.3	301.6	313.1	324.7	336.7	348.9	361.2	373.7	386.5
4 1-2	176.7	185.6	194.8	204.2	213.8	223.6	233.7	243.9	254.4	265.2	276.1	287.3	298.6	310.2	322.0	334.0	346.3	358.8	371.5	384.4	397.6
4 5-8	181.6	190.8	200.2	209.9	219.7	229.8	240.2	250.7	261.5	272.5	283.8	295.2	306.9	318.8	331.0	343.3	356.0	368.8	381.8	395.1	408.6
4 3-4	186.5	195.9	205.6	215.5	225.7	236.1	246.7	257.5	268.6	279.9	291.4	303.2	315.2	327.5	339.9	352.6	365.6	378.8	392.1	405.8	419.7
4 7-8	191.4	201.1	211.0	221.2	231.6	242.3	253.2	264.3	275.7	287.3	299.1	311.2	323.5	336.1	348.9	361.9	375.2	388.7	402.5	416.5	430.7
5	196.3	206.3	216.5	226.9	237.6	248.5	259.7	271.1	282.7	294.6	306.8	319.2	331.8	344.7	357.8	371.1	384.8	398.7	412.8	427.1	441.7
5 1-8	201.2	211.4	221.9	232.5	243.5	254.7	266.1	277.8	289.8	302.0	314.4	327.2	340.1	353.3	366.8	380.4	394.4	408.7	423.1	437.8	452.8
5 1-4	206.1	216.6	227.3	238.2	249.4	260.9	272.6	284.6	296.9	309.4	322.1	335.1	348.4	361.9	375.7	389.7	404.1	418.6	433.4	448.5	463.8
5 3-8	211.1	221.7	232.7	243.9	255.4	267.1	279.1	291.4	303.9	316.7	329.8	343.1	356.7	370.6	384.7	399.0	413.7	428.6	443.7	459.2	474.9
5 1-2	215.9	226.9	238.1	249.6	261.3	273.3	285.6	298.2	311.0	324.1	337.5	351.1	365.0	379.2	393.6	408.2	423.3	438.6	454.1	469.9	485.9
5 5-8	220.9	232.2	243.5	255.2	267.3	279.5	292.1	304.9	318.1	331.5	345.1	359.1	373.3	387.8	402.6	417.5	432.9	448.5	464.4	480.5	497.0
5 3-4	225.8	237.2	248.9	260.9	273.2	285.8	298.6	311.7	325.1	338.8	352.8	367.1	381.6	396.4	411.5	426.8	442.6	458.5	474.7	491.2	508.0
5 7-8	230.7	242.4	254.3	266.6	279.1	292.0	305.1	318.5	332.2	346.2	360.5	375.0	389.9	405.0	420.5	436.1	452.2	468.5	485.0	501.9	519.0
6	235.6	247.5	259.8	272.3	285.1	298.2	311.6	325.3	339.3	353.6	368.1	383.0	398.2	413.6	429.4	445.4	461.8	478.4	495.3	512.6	530.1
6 1-8	240.5	252.7	265.2	277.9	291.0	304.4	318.1	332.1	346.3	360.9	375.8	391.0	406.5	422.3	438.4	454.7	471.4	488.4	505.7	523.3	541.1
6 1-4	245.4	257.8	270.6	283.6	296.9	310.6	324.6	338.8	353.4	368.3	383.5	399.0	414.8	430.9	447.3	463.9	481.0	498.4	516.0	533.9	552.2
6 3-8	250.3	263.0	276.0	289.3	302.9	316.8	331.1	345.6	360.5	375.6	391.1	406.9	423.1	439.5	456.2	473.2	490.7	508.3	526.3	544.6	563.2
6 1-2	255.2	268.2	281.4	294.9	308.8	323.0	337.6	352.4	367.5	383.0	398.8	414.9	431.4	448.1	465.2	482.5	500.3	518.3	536.6	555.3	574.3

STROKE—INCHES	3 13-16	3 7-8	3 15-16	4	4 1-16	4 1-8	4 3-16	4 1-4	4 5-16	4 3-8	4 7-16	4 1-2	4 9-16	4 5-8	4 11-16	4 3-4	4 13-16	4 7-8	4 15-16	5
3 1-2	319.6	330.2	340.9																	
3 5-8	331.0	342.0	353.1																	
3 3-4	342.5	353.8	365.3																	
3 7-8	353.9	365.6	377.5																	
4	365.3	377.4	389.6	402.1	414.8	427.6	440.7	453.9	467.4	481.0	494.9									
4 1-8	376.7	389.1	401.8	414.7	427.7	441.0	454.5	468.1	482.0	496.1	510.3									
4 1-4	388.1	400.9	414.0	427.2	440.7	454.4	468.2	482.3	496.6	511.1	525.8									
4 3-8	399.5	412.7	426.2	439.8	453.7	467.7	482.0	496.5	511.2	526.1	541.3									
4 1-2	411.0	424.5	438.4	452.4	466.6	481.1	495.8	510.7	525.8	541.2	556.7	572.5	588.5	604.8	621.2	637.9	654.8	671.9	789.2	706.8
4 5-8	422.4	436.3	450.5	464.9	479.6	494.4	509.5	524.9	540.4	556.2	572.2	588.4	604.9	621.6	638.5	655.6	673.0	690.6	708.4	726.5
4 3-4	433.8	448.1	462.7	477.5	492.5	507.8	523.3	539.0	555.0	571.2	587.7	604.3	621.2	638.4	655.7	673.3	691.2	709.3	727.6	746.1
4 7-8	445.2	459.9	474.9	490.1	505.5	521.2	537.1	553.2	569.6	586.3	603.1	620.2	637.6	655.2	673.0	691.1	709.4	727.9	746.7	765.7
5	456.6	471.7	487.1	502.6	518.7	534.5	550.9	567.4	584.2	601.3	618.6	636.1	653.9	672.0	690.3	708.8	727.6	746.6	765.9	785.4
5 1-8	468.0	483.5	499.2	515.2	531.4	547.9	564.6	581.6	598.8	616.3	634.0	652.0	670.3	688.8	707.5	726.5	745.8	765.2	785.0	805.0
5 1-4	479.5	495.3	511.4	527.8	544.4	561.3	578.4	595.8	613.4	631.4	649.5	667.9	686.6	705.6	724.8	744.2	764.0	783.9	804.2	824.7
5 3-8	490.9	507.1	523.6	540.3	557.3	574.6	592.2	610.0	628.0	646.4	665.0	683.9	703.0	722.4	742.0	761.9	782.2	802.6	823.3	844.3
5 1-2	502.3	518.9	535.8	552.9	570.3	588.0	605.9	624.2	642.6	661.4	680.4	699.8	719.3	739.2	759.3	779.7	800.3	821.2	842.4	863.9
5 5-8	513.7	530.7	547.9	565.5	583.3	601.4	619.7	638.4	657.3	676.5	695.9	715.7	735.7	756.0	776.5	797.4	818.5	839.9	861.6	883.6
5 3-4	525.1	542.5	560.1	578.0	596.2	614.7	633.5	652.5	671.9	691.5	711.4	731.6	752.0	772.8	793.8	815.1	836.7	858.6	880.7	903.2
5 7-8	536.5	554.3	572.3	590.6	609.2	628.1	647.3	666.7	686.5	706.5	726.9	747.5	768.4	789.6	811.1	832.8	854.9	877.2	899.9	922.8
6	547.9	566.0	584.5	603.1	622.3	641.5	661.0	680.9	701.1	721.6	742.4	763.4	784.7	806.4	828.3	850.5	873.1	895.9	919.0	942.5
6 1-8	559.4	577.8	596.7	615.7	635.1	654.8	674.8	695.1	715.7	736.6	757.9	779.3	801.1	823.2	845.6	868.3	891.3	914.6	938.2	962.1
6 1-4	570.8	589.6	608.8	628.3	648.1	668.2	688.6	709.3	730.3	751.6	773.3	795.2	817.4	840.0	862.8	886.0	909.5	933.2	957.3	981.7
6 3-8	582.2	601.4	621.0	640.8	661.0	681.5	702.4	723.5	744.9	766.7	788.8	811.1	833.8	856.8	880.1	903.7	927.7	951.9	976.5	1,001.3
6 1-2	593.6	613.2	633.2	653.4	674.0	694.9	716.1	737.7	759.5	781.7	804.3	827.0	850.1	873.6	897.3	921.4	945.9	970.6	995.6	1,021.0

American Ambulances in the Field

Equipment of American Hospital in Paris Over 100 Cars—Compactness and Practicability Feature Body Design—Work Is Quick and Efficient

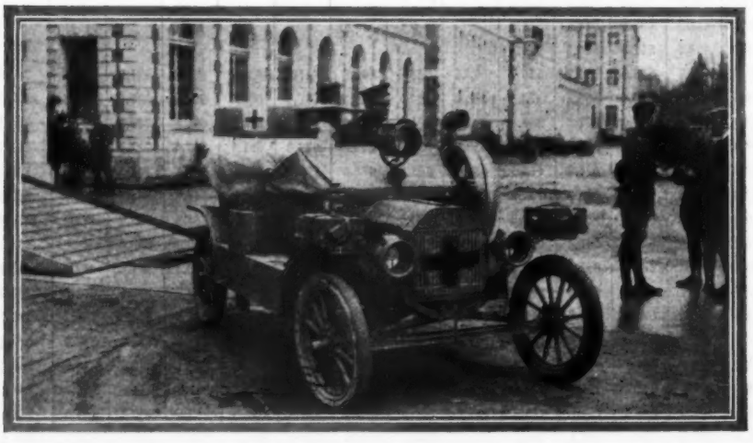
WHEN the war trumpet had sent national institutions tottering, when the railroads and highroads were monopolized by men going forth to fight, when American tourists were struggling to escape from a country in which their dollars and their check books had become so much trash, when all Europe was shrieking or benumbed at the pestilence which was about to fall upon it—at that moment a group of American citizens in Paris rolled up their sleeves and prepared for the grim work they saw just ahead of them.

The modern and scientifically equipped American Hospital at Neuilly formed the nucleus and an almost completed high school building in the same suburb of Paris provided the necessary extension for an army hospital. As quickly as if the dinner bell had sounded, the men in that high school building had dropped their tools to take up rifle, lance or machine gun. But for them there was no after-dinner return. Their work was not sufficiently advanced to make the building fit for the youth of France, but it was in such a condition that the bare halls could be quickly transformed into wards and offices. With plenty of hard work, American goodwill, and the necessary financial backing, the unfinished Lycée Pasteur, abandoned by its workmen transformed into soldiers, was in a few days a military hospital with accommodation for 900 men.

Ford ambulances attached to American hospital, Paris. These are some of the earliest machines, having had 3 months' active service on the battlefields in France and Belgium

A civil hospital might exist without automobiles; to a military establishment they are as necessary as the steam to a steam engine, the clients to a store, the water to a mill. During the moments when nations are switching over from peace to war, automobiles are valuable and scarce. The American Hospital committee discovered its first automobiles at the Paris branch of the Ford company. But they were not ambulances, and to make them into such the Ford company employed the cases in which the automobiles had been brought from America, and even tore up some of the flooring of their cinema theater.

From that hasty beginning a wonderful organization has sprung up. It would be more correct to say has been built up, for automobile organizations, whether they be ambulances or factories can only be brought into being by persistent and conscientious work. At the present moment there are attached to the American Hospital in Paris, about 100 automobile ambulances. Fords predominate; their companions are English Daimlers and "Jumbo," an eight-cylinder De Dion Bouton with a horsevan body—but instead of racehorses it carries wounded soldiers.

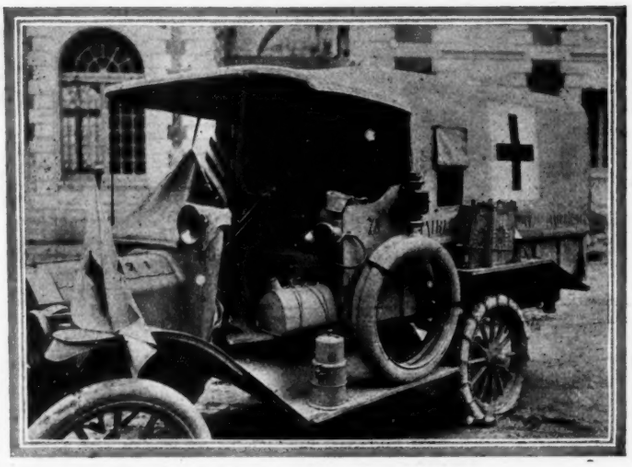


Section commander's car attached to American ambulance. Note reserve gasoline cans on front fenders and top of tool box

Nearly All Volunteers

A staff had to be got together. America supplied it before it was asked for. The list of names in the office of the Captain of Ambulances is worth looking over. Alphabetical classification puts at the head an ex-governor of Porto Rico; he is followed by an ex-assistant secretary of the treasury, the son of a well-known cotton king; ex-army officers, Harvard men. The paid workers might be counted on the fingers of one hand; the men who are driving automobiles as well as those who are sweeping wards, washing wounds, and preparing bandages come from homes of luxury and an environment of wealth.

Tommy Atkins, who has done much to increase the world's vocabulary since this war began, has hit upon a happy expression. The British soldier was wounded; he was making his way to the rear as best he could, when a Ford from the American Hospital came dancing down the greasy, granite paved, mud bordered highway. It jumped off the paving stones into the mud bath, and from the mud bath back to the paving stones; it slipped past convoys and worked its way past wrecked machines; finally it pulled up in front of the Britisher. "Blime if that ain't another of them bloomin' bleedin' jumpin' bedsteads," remarked Tommy as they lifted him aboard. And "jumping bedsteads," with as many adjectives as imagination can supply, the Fords have remained until this day.



Detailed fittings of one of American ambulances. Shoes and generator on running board, spare gasoline and kerosene on fender, sterilized water bottle at driver's feet, spare tubes in locker at driver's elbow

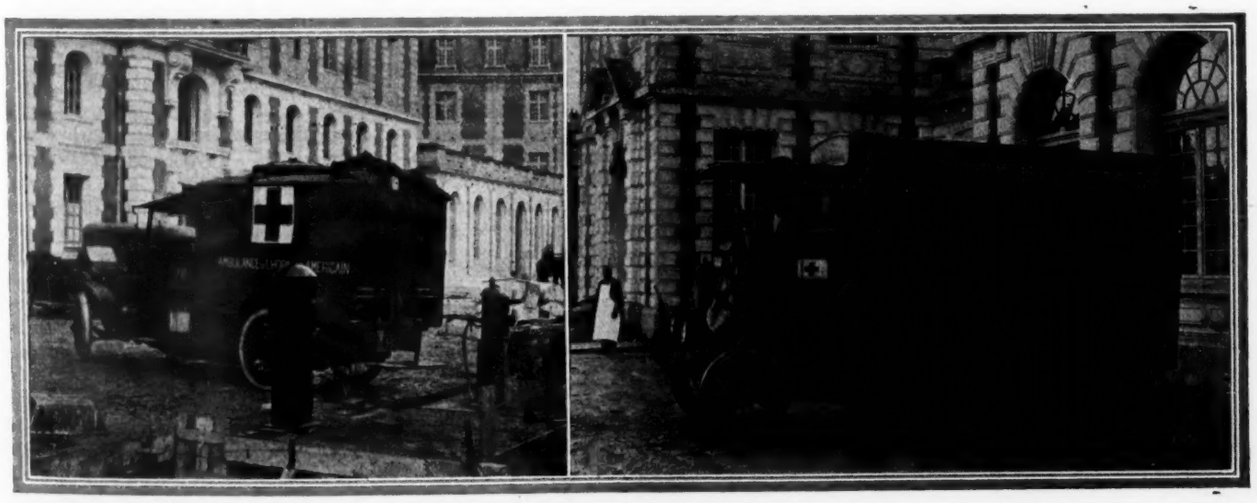
How these machines were brought up to a state of perfection is a story of some interest to automobilists. Before it can be told some explanation must be given of the work the cars have to do and how they do it. Although the hospital is a private institution, the entire organization is under military control. Every automobile carries a military number and every driver is almost as much under military control as the Englishman who has taken the King's shilling, or the conscript owing allegiance to France. In the earlier stages of the war, particularly when Paris was threatened, the ambulances made out and home trips from the hospital to the battlefield. They picked men up where they had fallen and brought them direct to the hospital in the suburbs of Paris. Now that is changed. The firing line is some distance away and the automobiles are sent out in sections and squads, to remain in the field for any period from 3 weeks to 3 months, to work under army directions, while at the same time maintaining their individual organization. The work is varied. It may be taxicab service in some town 50 miles from the battle line; it may be picking up wounded practically on the battlefield and carrying them to the field hospitals; it may be the removal of sick and wounded men from the field hospitals to the base hospitals or to the hospital trains some miles back.

Many Emergency Calls

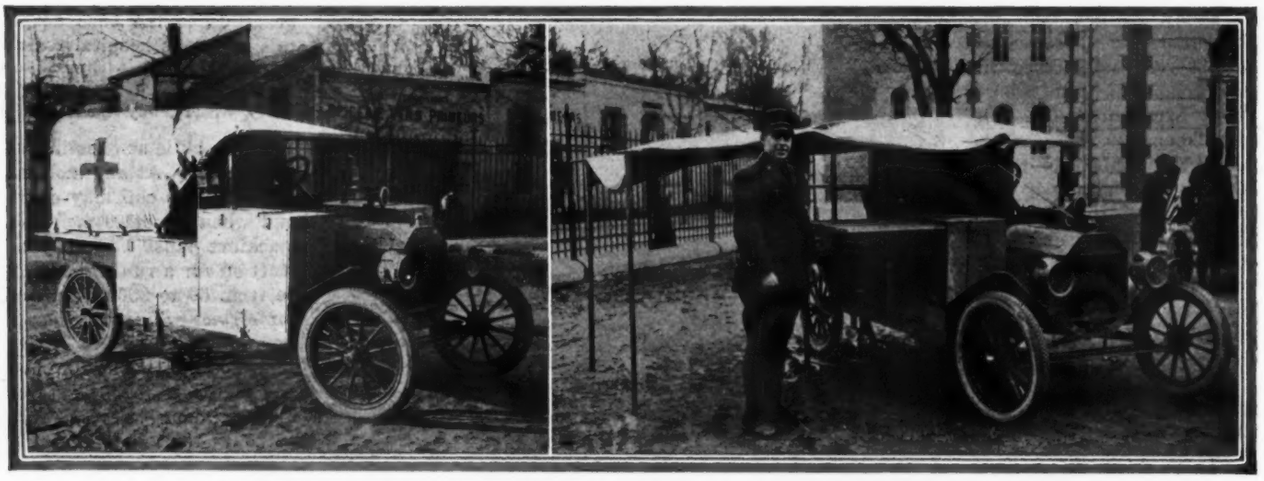
The work is as exacting as it is varied. At any moment the hurry up call may come, and when it comes men and machines must be ready to start off for a run which may be from 50 to 250 miles, and for service which may last a few minutes or a few hours. It is not infrequent for men and machines to be kept going continuously for 18 hours without the motors being stopped.

A squad consists of five ambulances, a supply car and a touring car. A section is made up of two squads, or twelve vehicles, ten of them being ambulances and two respectively a supply car and a touring car. In the majority of cases the ambulances work in sections, for these are absolutely self contained, carrying with them all necessary parts to meet every possible emergency, and requiring nothing more in the way of outside supplies than gasoline and oil to keep them running indefinitely.

Each ambulance is built to receive a couple of army type stretchers, or to carry four wounded men sitting, thus making, with the driver and attendant, a maximum load of six men. It is a rule to carry four orderlies for six ambulances. Owing to the small dimensions of the vehicle it has not been an easy matter to fit up the Fords in a satisfactory manner. The body is of wood and canvas, with the canvas fastened down permanently all round except at the rear. Here there is a hinged tail board with canvas curtains above it fastened by turnscrews. There is a considerable amount of overhang, and the army stretchers are a little longer than the body. Thus four holes have been cut in the tailboard and canvas bags fitted over these. This allows the ends of the stretchers to project, but prevents cold air entering. When men are sitting on the transverse benches hooked to the side panels, they have a tendency to get to the rear, in order to look out, thus upsetting the balance of the car. This is overcome by fitting a mica window on each side forward; the men move



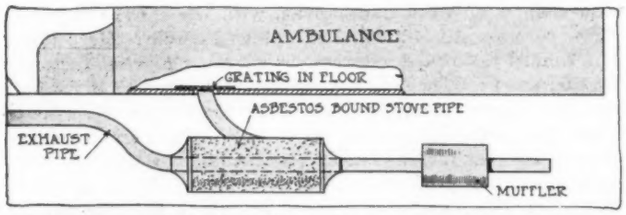
Left—The English Daimler attached to an American hospital, Paris, taking on gasoline. Right—Jumbo—An eight-cylinder De Dion Bouton which formerly carried race horses. Fitted as an ambulance it can move eighteen men at a time



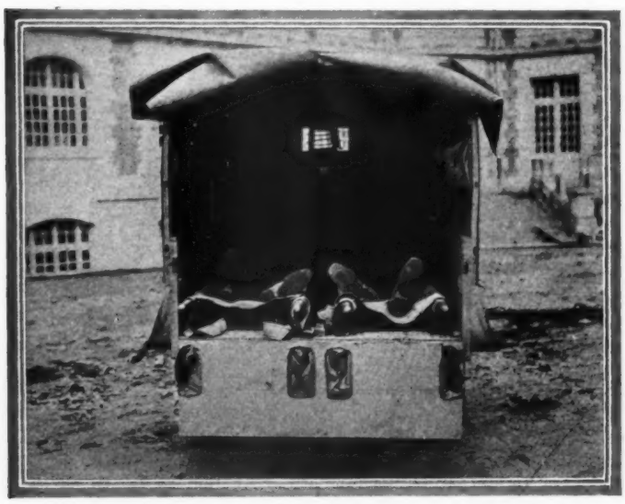
Left—Ford store and workshop ready for the road. Right—Ford repair car fixed up for service

upwards to look out of this and in doing so evenly distribute the load.

As soon as the cold weather set in, the French army asked for heated ambulances. The American Hospital tried to meet the want, and after some experimenting produced a simple heating apparatus of such efficacy that the Ford was dubbed by French soldiers "L'Hotel du Courant d'Air—Chauffage Central" (Drafty Hotel—Central Heating). Mr. McFadden, one of the voluntary workers who tackled this job, fitted a stovepipe around the exhaust pipe, closed up the ends, bound it with sheet asbestos, and carried a lead from the stovepipe through the floor level with the heads of the men lying in the ambulance. The opening is covered with a grating. This arrangement will raise the temperature of the ambulance 17 degrees in half an hour. It supplies pure hot air, and has the advantage of costing but $4.



Ingenious method of heating Ford ambulances. Section of asbestos-bound stovepipe with closed ends is fitted around the exhaust pipe and a lead carries the heat to a grating in the floor of the ambulance



How two wounded men are carried in one of the American ambulances

One of the objections to the Ford was the use of odd size tires. The ambulance people finally discarded the 3-inch tires on front wheels in favor of 3 1-2; they thus avoid carrying two size tubes and casings, an important matter when every ounce of weight has to be considered; they obtain better tire service, and according to some of the drivers the cars are easier to steer. The lighting outfit had to be simplified; there were originally too many bends in the pipes and no provision for drawing off water. Electric lighting was tried and abandoned, the experience of the ambulance people being that it is unsuitable. Further, the British army authorities refuse to allow any car to be in service at the front with electric lighting only. If electric lighting exists, it must be supplemented by gas. Each car carries two spare casings, either on the left hand running board or on the roof extension above the driver's head. Spare tubes are contained in a box at the driver's elbow. The gasoline supply for each car is 35 liters, or 7.7 gallons, in tank, and 30 liters, or 6.6 gallons, in reserve. This reserve supply is contained in 6 cans, 3 on each rear fender, in addition a small supply of kerosene is carried for side lamps and a reserve of 2 gallons of lubricating oil. This reserve supply must always be maintained. In this way the ambulances are ready to respond to every call for a distance of not less than 250 miles without any outside supplies being needed. Under the canvas apron which replaces the glass windscreen, every driver has a bottle containing sterilized water, and a military kitchen with all eating utensils.

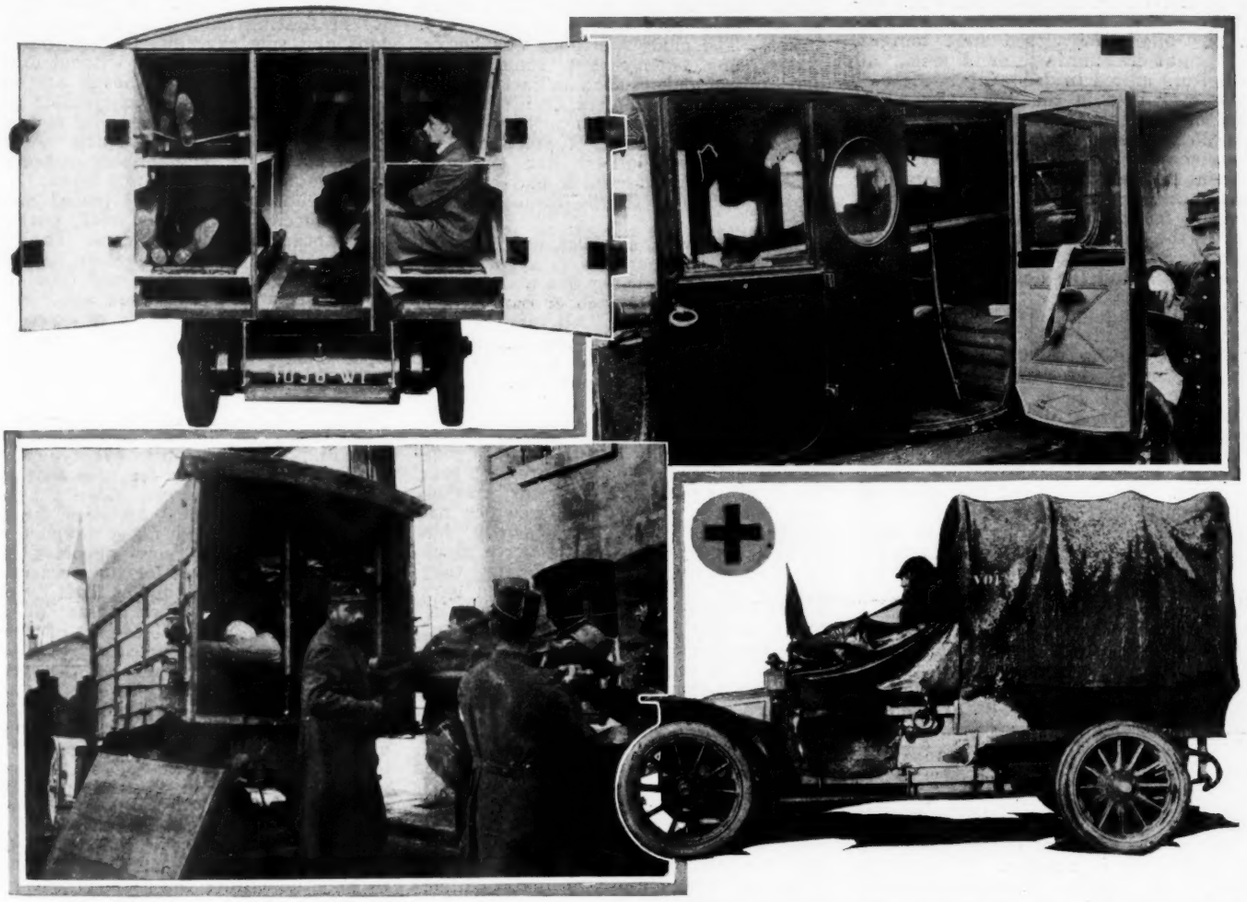
Cars Marvels of Compactness

The touring car and supply car which travel with every section are marvels of ingenuity. All jimcrack ideas have been driven out by the stern realities of war, and the touring car can handle all the kit and food of the men in its section, while the supply car has enough spares to build a complete Ford car. The problems in the supply car were to have the load distributed so that the weight should be carried with the least possible strain, to make every spare accessible, and also to render control of the stock easy. This car carries a radiator, cylinder casting, set of pistons, rear axle, spare wheel, steering levers, and a stock of small parts usually only to be found in an automobile store. The general arrangement, for which Fred B. Bate is responsible, is shown in the illustrations. Boxes for spare parts are built all around the car in such a way as to get the load well centered and as low as possible. The body is of wood and canvas, with the canvas sides capable of being extended and held up by props so as to form a convenient workshop. Within

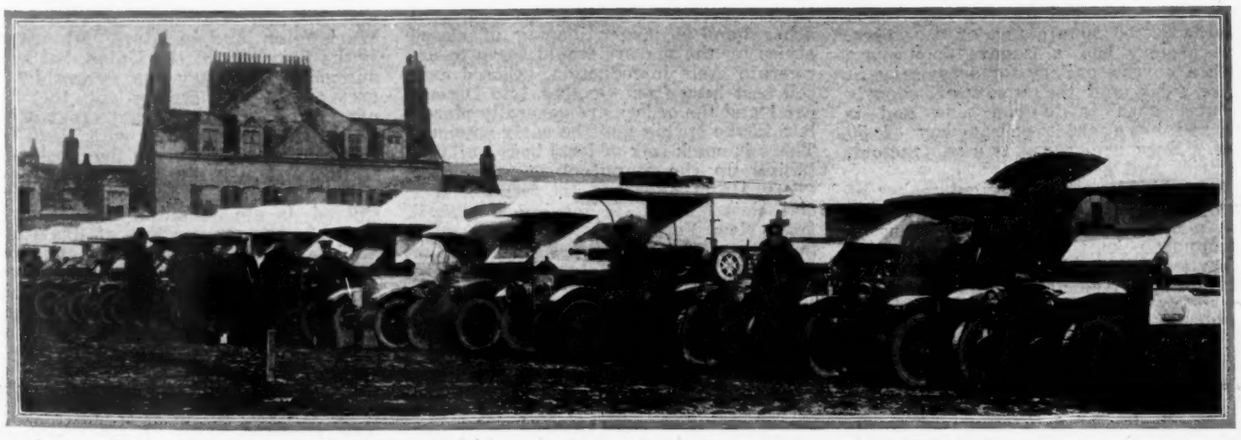
the body are shelves receiving metal boxes for such articles as bolts, nuts, gaskets, nails, screws, spark plugs, etc. Every cupboard is numbered and a list maintained of every article in each cupboard. As a note is made of every part given out to drivers, the keeper of the supplies knows exactly what stock he has in hand and can supply any part at a moment's notice.

It will be asked what are the mechanical troubles which develop with this type of machine. They are surprisingly small. Spark plugs give a lot of trouble; under the heavy going brake bands fail more frequently than in normal service. But this is about all. The accurately kept list of spares supplied to a section of 12 cars which had been at the front for eight consecutive weeks showed nothing more important than a set of steering levers (damaged in a collision) hub caps, gaskets, spark plugs, switch keys, headlight burners, tail lamps and brake bands.

The war has reached such a stage that it is necessary to keep very few ambulances at the hospital in Paris. The Captain of Ambulances is striving to keep his whole fleet in the field, under the direction of the military authorities. When a section comes back—it may be after a couple of months' constant service,—it is repaired, overhauled, given fresh supplies and sent back into the field.



Upper left—British army ambulance designed by J. J. Mann, of the Daimler company, which can carry six men lying or two lying and three sitting. Upper right—This Sizaire-Berwick carries two stretchers, thus providing comfortable sleeping accommodations for the driver and his mechanic. Lower left—Bringing in wounded French soldiers by motor ambulance. Lower right—Two-cylinder Renault Paris taxicab converted into an ambulance for service in the French army



Convoy of British Red Cross automobiles in France ready for use at a moment's notice

Northwest Farmers Offer Big Car Market

Great Minneapolis Distributing Show for Tremendous Territory of 316,134 Square Miles Closes—25,000 Cars Sold Last Year in This Region —50 Per Cent. Increase Is Expected for 1915

MINNEAPOLIS, MINN., Feb. 6—When the eighth annual automobile show closed here tonight, after running for a week, all exhibitors united in declaring it the best show ever held in the Twin Cities. It was the best show because its attendance was 25 per cent. above that of any previous show held here. The dealers were present in greater numbers than ever before, in fact, over 4,000 dealers were present from this territory which includes the states of Minnesota, North Dakota, South Dakota, the eastern half of Montana and the northwestern counties in Wisconsin.

The Minneapolis show is not a retail show for this city and St. Paul, but a great distributing show for the Northwest section of the country. The dealers came in to place specifications for shipments of cars to the territory and generally bring with them hundreds of prospects who want to look over all the different makes of cars before finally selecting. As a result of the show the Minneapolis distributors have orders on many car load shipments, and in addition many retail sales are made, but yet it is not in any sense a retail show, although the Twin City citizens attend in large numbers, the paid attendance alone for the week exceeding 40,000. To this you can add the tens of thousands who get tickets from dealers, which bring the attendance figures well up. Twin City dealers of small cars selling under $1,000 do not expect to make many retail sales, but do get names of many prospects.

Show week is the second biggest week of the year for the Twin Cities, the fall fair week in the fall bringing greater crowds to the city, but the money spent in show week is greater. Minneapolis and St. Paul are the great buying cities for the territory, in fact, they are familiarly known as the gateway to the Northwest.

As an automobile show the Minneapolis exhibit is one of no mean proportions. The National Guard Armory and Annex affords 50,000 square feet of floorspace. The armory has a square floor space with a narrow gallery for accessories in three sides, and the annex of slightly greater area is to one side and is reached by a short passageway of 50 feet. Here are cars, trucks, tractors, electrics and accessories.

All told fifty-eight different makes of gasoline passenger cars were exhibited, five makes of electrics, seven makes of gasoline trucks, three makes of gasoline farm tractors, and fifty-two accessories. The totals of vehicles exhibited were:

Gasoline passenger cars	163
Electric passenger cars	13
Gasoline trucks	13
Gasoline farm tractors	4
Total	193

The display of cars compared favorably with that in New York and Chicago, many of the exhibits from these shows being sent bodily to the Twin Cities. The chassis display was heavy, there being twenty-eight, some of the high- priced makers such as Packard, Reo had two, a four and a six, Cadillac, Overland, Jeffery, Chandler, Studebaker, Dodge, Velie, Maxwell, Hupp, Chalmers, Dort and many others had cut-away chassis, a few of which had constant crowds listening to the demonstrators' talks.

The display of electrics was particularly good—Minneapolis is a good electric center, there being five makers represented, Detroit, Rauch & Lang, Ohio, Milburn and Chicago. All vehicles were closed types, excepting the Detroit cabriolet or roadster style, a vehicle well suited for all-year-around use.

Closed Cars Neglected

Minneapolis and St. Paul, with a combined population of 535,000 are each year becoming a better closed car market, and berlines, sedans, and coupés are coming into their own, slowly but surely. Few of the makers have given the distributors here the assistance they deserve, as the number of closed cars shown is lamentably small. In the gasoline field they totaled eleven, made up of four berlines, four sedans and three coupés. In contrast with these figures were thirty-four roadsters and 118 touring cars. The limousine cannot be considered, in short, it is not here. The Twin City family prefers the berline with its removable windows or partition between the driver's compartment and the passenger compartment, so that the owner can drive if so inclined. Locomobile, Winton and Packard showed berlines, Overland, Cadillac, Franklin and Stutz had sedans, and Overland, Cadillac and Scripps-Booth showed coupés. The local dealer and distributor does not want to buy a berline or sedan from his factory for this show as the selling season is nearly over and he would have to carry it over for the fall of 1915. On the other hand a larger display of closed styles by the makers would serve to accelerate their introduction. Closed cars sell best here from October 1 to December 1 and the orders are generally placed late in the spring and the early summer. There is much talk of local body builders taking up the manufacture of closed types. In other words, the trend of special closed bodies is moving westward from New York to Chicago. All week in spite of the worst snowstorm of the season and in spite of temperature close to zero, at times, and in spite of more snow than this city is accustomed to, automobiles were out every day and every night in full force. One night 150 cars were lined up in the open square in front of the Armory, notwithstanding a blinding snowstorm and the next night nearly as many were counted under one of the clear, frosty nights for which the territory is renowned. The great majority of touring cars were fixed up with tops and side curtains, in fact, you do not see a touring car here without top or side curtains up. The hoods are well bundled up with padded jackets and blankets. Looking at these cars and considering the push-ahead spirit of this territory one is very forcibly impressed with the field here for closed types.

Minneapolis distributors placed many new agencies during the week, particularly those handling new cars. Thus W. E. Wheeler of the Northwestern Automobile Co., handling Saxon and Chandler, arranged for forty or more agencies in the territory. Milton Brice, of Brice Automobile Co., selling the Grant, appointed fifty to sixty new dealers. The La Crosse Implement Co. appointed thirty-five to forty new Dort agencies. The Pathfinder Motor Car Co., which is extending itself in this territory, appointed ten new dealers. These examples are typical of the value of the show for cars that are relatively new, whereas old-established makers add few new agencies during show week. Although many distributors placed few, if any, new agencies, yet their dealers from the territory attended in good numbers so that at least 50 per cent. of all dealers were present at the show. Overland has 150 dealers of whom 120 were in attendance; Studebaker had 225 at its dealers' dinner. Of the sixty-five Paige dealers, thirty-five were at the show; Mitchell had 110 of whom thirty-five were here; of the 100 old Grant dealers, seventy-five were in the city; Reo has 140 selling agencies in the territory and ninety attended the show; of 250 selling Saxon and Chandler, 125 were here; Franklin has twenty dealers of whom ten attended; Pathfinder reported the same figures; and with such leaders as Ford and Buick the representation of agents was particularly high.

The Territory

Minneapolis and geography are always closely associated just like New York and money, Chicago and stockyard, Washington and senators. Minneapolis is the flour city of the Union, but in the automobile industry the geography aspect of the city crowds out the flour phase. You get into a new range of distance here as compared with New York or Boston. Here area is the dominating feature.

The Minneapolis territory, when considered, is almost stupifying. Roughly it embraces more or less of five states, all Minnesota, North Dakota and South Dakota, the eastern half of Montana and a little northwestern corner of Wisconsin. This area looks big on the map but it is when you get it in figures that you start to comprehend its proportions. In area, the territory is one-eleventh of our country, including Alaska. It totals 316,000 square miles of country. Little New England, with its six states, has but 66,424 square miles. You could prac-

tically put five such areas into the territory that the Twin City automobile distributor has for his selling zone. No wonder out here they talk distributor, not dealer; but let us get a little more tangible grasp on the Twin City selling territory. This Minneapolis territory is almost equal in area to that of the following thirteen states: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Maryland, Pennsylvania, Ohio, Indiana and Illinois. Is there any wonder that out here is a robust spirit?

The great territory is exactly one-half larger in area than either Germany or France. You could lose twenty-eight little Belgiums in it. It is over twice as large as Japan. Note the table of comparative areas herewith.

In the population chart the figures are not so formidable but they are increasing very fast each year. The population of the whole Minneapolis territory is nearly 4,000,000 as compared with 6,552,681 in New England in 1910, but car buying is not in proportion to population. In other words, the number of cars owned for each 100 population is much higher in Minneapolis territory than in the New England zone. When you think of cars out here you think of farmers. They are the great big, overwhelming, dominating factor out here. They own the territory and Minneapolis and St. Paul are mere necessary excrescences. Going through the show and talking to exhibitors you get almost calloused to such expressions as: "I sell 75 per cent. of my cars to farmers, or 90 per cent. of our sales are with farmers." This is the farmers' country. There are 384,000 of them in the state of Minnesota and of these not 10 per cent. own cars. One-half the annual output of the country could be sold in this state alone for a year or two. To this you must add the two Dakotas and the east half of Montana.

The Farmer

The farmer has more money today than he has ever had before. What is the answer? Minnesota and the two Dakotas have this year produced 280,000,000 bushels of wheat and the farmer has sold it at an average of 50 cents per bushel ahead of any previous year. This means $140,000,000 additional going to the farmers in these three states. The state of Minnesota alone has a wheat crop of 90,000,000 bushels, meaning $45,000,000 additional more than the farmer looked for.

From this additional wheat money of $140,000,000 the implement man and the automobile dealer are going to benefit most. They come first with wheat selling here today at $1.54 per bushel, the farmer is getting $1.37 per bushel at the grain elevator. On August he was getting 95 cents per bushel and the price has been rising steadily ever since.

No wonder 90 per cent. of the cars are owned by the farmers. During 1914 the number of cars in Minnesota increased 50 per cent. November 1, 1914, there were 64,185 cars registered in the state. A year previous there were 42,664 cars registered. *The Farmer*, of St. Paul in a recent analysis of the cars sold in Minnesota last year, says that 63 per cent. of the 21,521 cars sold went to people whose postoffices are in towns of less than 3,000 population. This is another way of saying that these cars were sold to farmers. In North and South Dakota the same is true, only more so. The farmer is the big buyer. He is brawn and sinew of the industry in this great distributing zone. Farmers in this zone are divided into two classes: the grain farmer and the dairy or mixed farmer. The first grows only grain, wheat, oats, etc. He is found in western Minnesota and in the Dakotas. The dairy farmer grows grain but has many cattle, sheep and swine and depends upon a variety of sources of income. He gets money in each month for the sale of cream, he sells stock and sells grain. He is found in Wisconsin and generally in eastern Minnesota. He is invading a few of the Eastern counties in the Dakotas. His money comes in off and on during the entire year. Contrast this farmer with the one who grows grain only. He sells his grain in the fall and gets his money in once a year, and who if his grain fails has no other source of income. Place yourself as a dealer selling to such, selling 90 per cent. of your output to them. Begin with the basic assumption that you must do business on a credit basis. You must sell for a little cash and take notes at 3, 6, 9 and 12 months for the balance. That is how cars are sold to these farmers. The dealer gets as much cash as he can and takes notes for the balance. In Minnesota, notes in the mixed or dairy farmer territory are for short periods, 3 or 6 months, and carry interest at 6 or 8 per cent. In the grain farming sections the notes often run for 9 or 12 months and carry 10 per cent. interest. The dealer takes these notes to his banker, who gives the dealer their face value in cash. When the notes are due the banker notifies the dealer who in turn notifies the farmer and makes collection, so that often the farmer does not know the bank has held the note. Farmers prefer to do this in preference to going to the bank for a loan, as often the banks aim to discourage the farmer from buying a car. These farmers have been buying on credit since they settled in the territory and you cannot do business with them at present on any other basis than credit.

Want Touring Cars

The farmers want touring cars, not roadsters. They all have families, hence a rational five-passenger car; and they want power, as many roads are heavy and hills steep. As a result, horsepower is a greater selling factor in this territory than in New England or the East with its improved roads. This explains why several makers of small cars building only runabouts a year ago have brought out touring cars, thus referring to such as Saxon, Grant, Metz, etc. In the Dakotas the farmer is buying a two-wheel trailer carrying a box 3 by 8 feet. He attaches this to a cross-bar fitted above the rear spring and on this trailer he can carry a load of 1,500 pounds at a speed of 22 miles per hour. In general the farmer wants a tonneau type, so he can carry his produce to market, bring home his flour, groceries and binder twine; in short, his automobile has entirely replaced his horse vehicle on the road except for taking grain to the elevator.

These farmers do not take the best care of their cars. Some are not washed from January to December, as in the alkaline sections in South Dakota and Montana the body finish is soon ruined, black suffering quickest.

Buy on Credit

Farmers who buy cars on credit expect to buy accessories, tires, gasoline and oil and also get repairs on credit. This is another big dealer's problem. In the dairy country with cream checks coming in once a month the dealer gets his money with reasonable regularity, but in some of the grain sections in Dakota, Montana and western Minnesota there is pay only once a year and that if crops are good. Often the dealer carries the account for 6 months and then takes a note for 6 or 9 months with 10 per cent. interest. But heroic efforts are being made to get repairs and accessories on a cash basis. In Montana, F. E. Doran in Lewistown, a town of 6,000 population, started on a cash basis last August and now all the dealers in the town have followed suit. He has issued coupon books with $25 worth of coupons which he sells for $22.50 or 10 per cent. discount. These are sold for cash. The coupons are good as payment for everything except tires and paying for a new car. In the first month he sold seventy books and now the farmers are well pleased. Before making the change Mr. Doran had printed posters placarded all through his territory and he advertised the fact that dealers in South Dakota and other parts of Montana are now adopting this new cash scheme. The dealer in the West calculates that it costs 10 per cent. to make collections, and the discount of 10 per cent. allowed on the coupons is very attractive to the farmer. The coupon books are the same size as a conventional blank check book. The coupons are in $1.50, 25, 10 and 5 cent denominations.

The war has not seriously affected this section. August 1, when war was declared, there was a lull which continued for nearly a month, but since then business has been above normal because of the unprecedented wheat market.

Minneapolis Territory

	Area Square Miles
Minnesota	84,682
South Dakota	77,615
North Dakota	70,837
Half of Montana	73,496
Wisconsin (part)	10,000
Total	316,134

13 Other States

	Area Square Miles
Maine	33,040
New Hampshire	9,341
Vermont	9,564
Massachusetts	8,266
Rhode Island	1,248
Connecticut	4,965
New York	49,204
New Jersey	8,224
Maryland	12,327
Pennsylvania	45,126
Ohio	41,040
Indiana	36,354
Illinois	56,665
Total	315,364

Foreign Countries

	Area Square Miles
German Empire	208,780
France	207,054
Belgium	11,373
Japan	147,655
Russia	8,647,657
China	2,169,200

Double Oiling System in Duesenberg

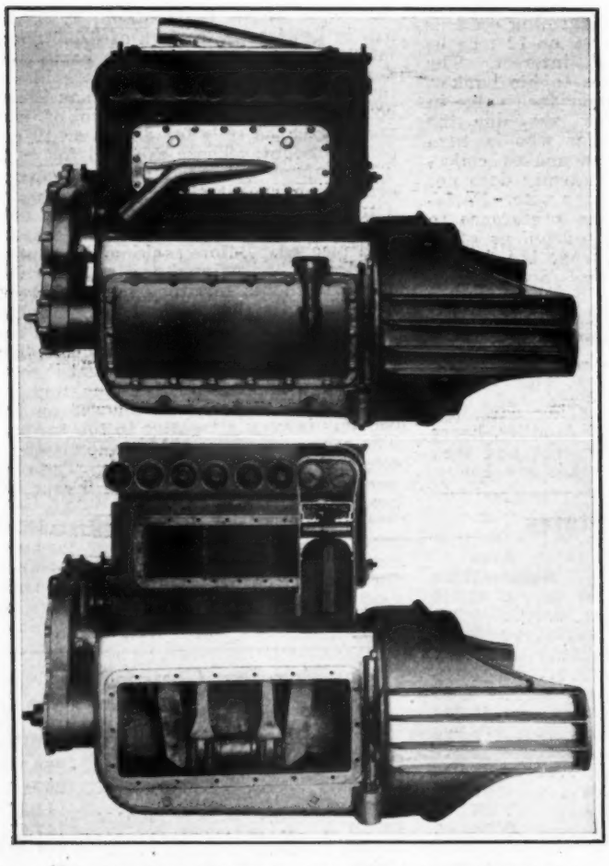
Duplex Oil Pump Replaces Single Type, Keeping Oil Always Cool

THE Duesenberg Motor Co., St. Paul, Minn., which has made a creditable showing for its engines in speed contests the past few seasons, is to continue them as a type for high speed cars in four-cylinder designs ranging in size from 4 by 6 inches to 4 3-8 by 6 inches.

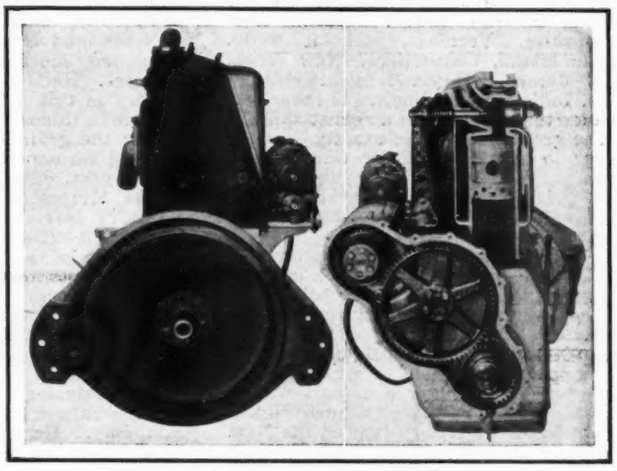
The general design and construction of these motors is the same as used the past two seasons in the concern's racing cars, with the exception that a double oiling system is now employed, a duplex oil pump being fitted in place of the former single type. It is the duty of one of these pumps to send the oil to the bearings and reservoir at the bottom of the motor, keeping the level here constant at all times. The other pump is used for taking away the overflow from the motor and returning this surplus to the main oil tank. It is pointed out that the new system has the advantage of keeping the motor supplied with cool oil at all times and avoids the possibility of overfilling the crankcase with lubricant.

Valves Are Horizontally Set

The distinctive features of the Duesenberg design are that the intake and exhaust valves are all set horizontally in the cylinder head, and the valves are operated by vertically-positioned rocker arms, one for each valve. The lower ends of these rockers bear on the cams, and the upper directly against the valve rods. With this construction, the valves, as in valve-in-head engines of the usual form, open directly into the cylinder heads without pockets. The valve construction is clearly seen in the end sectional view, and a plate goes over the valve rockers and valves, inclosing them effectively against dust and dirt, and also quieting them.



Duesenberg has two-bearing crank and very light pistons



Showing method of valve operation

Opposite to the valves are plugs in the center of which are the spark plugs, which make a simple head. The exhaust passages go directly upward to individual openings, while the passages to the intakes are cored within the cylinder casting, and the carbureter attaches by a single flange.

The motor uses a two-bearing crankshaft, and special magnalium racing pistons of light construction and having large oil holes in the lower part below the wristpins. The drive for the camshaft, water pump and magneto is by spiral gears, housed at the front.

The smaller motor—4 by 6—uses the same crankshaft and bearings as the larger size and also has the same valve area; therefore, the motor is capable of higher speeds than the larger type.

Both motors are furnished with rear supports to take the Brown-Lipe or other standard gearsets. On any installation, however, the three-point suspension principle is retained, the front end of the motor resting in a cradle lined with leather, thereby making for wear reduction and the lessening of vibration.

Flexible Leather Shaft Couplings Replace Metallic Type

IT is practically impossible to make a metal universal that will not chatter after a certain amount of wear has taken place and this fact has lately led to the use of joints in which the flexibility is given by the material. Used first for magneto couplings, leather was tried as long ago as 1911 for the propeller shaft on Isotta-Fraschini cars, and has been continued ever since, it is also used on all the Daimler passenger buses for the shaft drive.

Though few manufacturers have had the courage to follow this example, leather has been adopted widely for clutch coupling on chassis with separate gearboxes, and it is now the favorite material for coupling small parts such as magnetos, water pumps or even generators.

The original Isotta-Fraschini joint was as shown in A,

Fig. 1, there being a disk of leather held at its circumference by a ring and driving through a smaller concentric ring. This stresses the leather more than the other type B which is the common form. An advantage of the leather for drive shaft coupling is that it is cheap and easy to renew if it should eventually fail and on bus service it is claimed that renewal of the leather every 30,000 miles or so is less costly than the re-bushing and lubrication necessary with metal universals.

Usually where leather disks are employed, the two shaft ends to be joined are fitted with a form of cross piece with provision for bolts at the extremities. In assembling, the two shafts are arranged with the cross pieces at right angles, and thus the leather ring interposed between them is bolted first to one and then the other. This obviously gives enough flexibility for the desired purpose.

The National Shows, where so many different cars are assembled in a small space, afford excellent opportunities for comparing the different types and modifications of couplings as well as other features. The sketches herewith depict some of the couplings on view at Chicago, no attempt having been made to show them all—simply a representative array taken at random.

Either an oak leather or a good grade of rawhide is best for the purpose in the majority of cases. It must be tough enough to take the drive without wearing the bolt holes so as to give no play there as, in time, this would tend to tear the holes in the leather sufficiently to cause trouble.

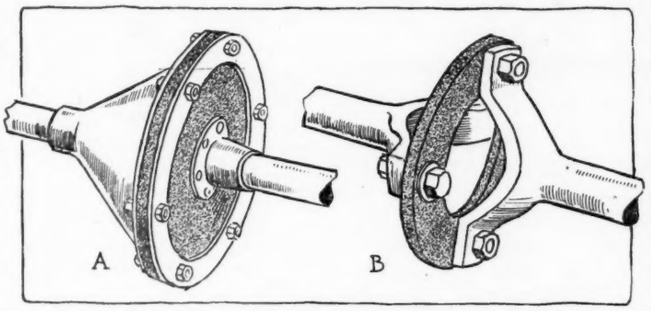
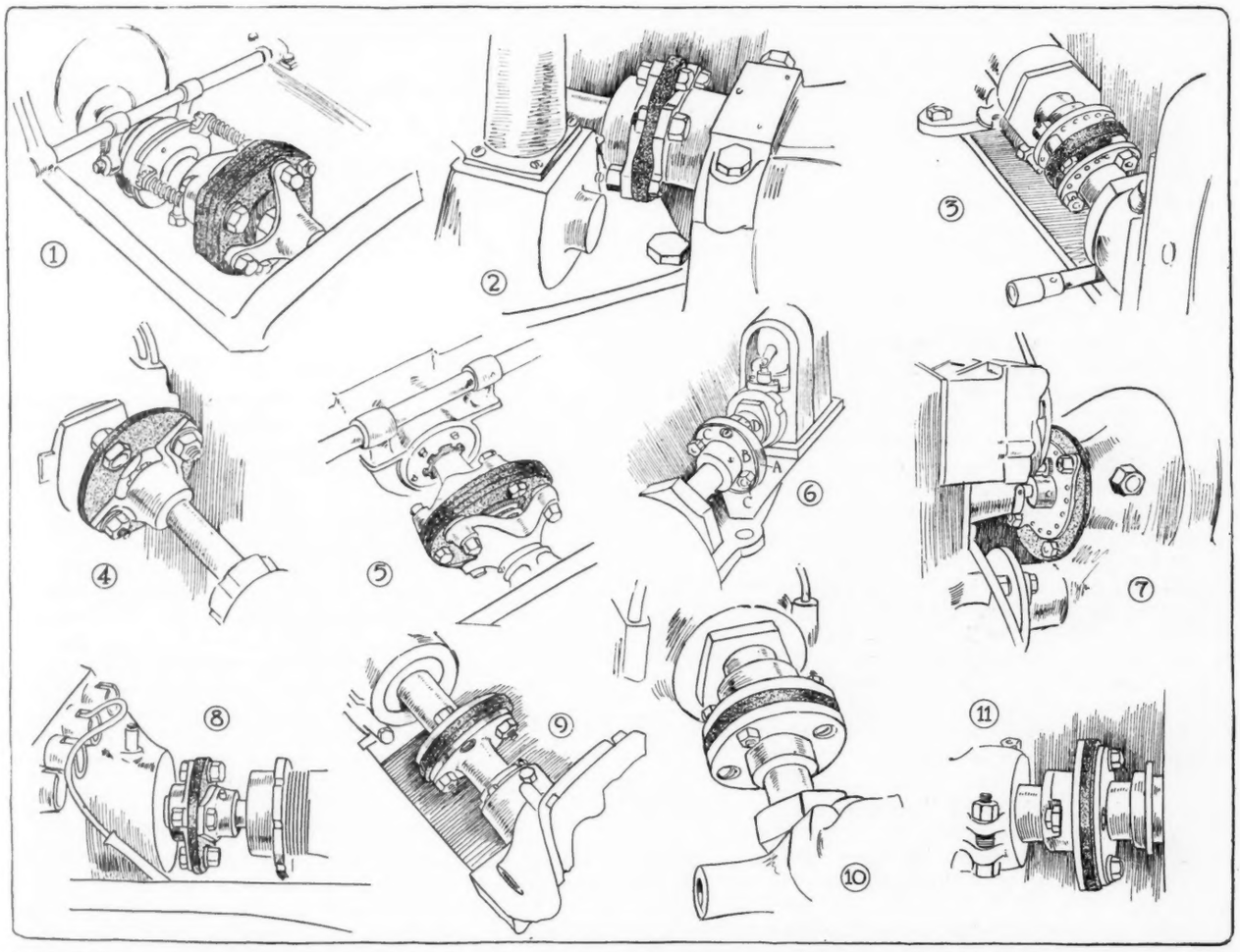
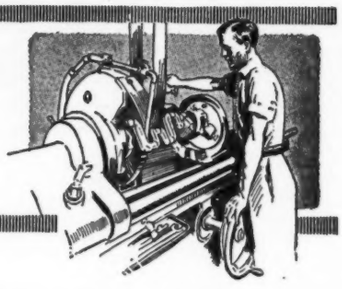


Fig. 1—A—Isotta-Fraschini coupling; the original design in which a real disk is used driven at its outer edge and driving through the center flange. B—The modern style using a ring of leather



1—Daimler form of coupling on Jeffery between clutch and gearbox; oak leather rings with corrugated steel washers mounted between them on the clamping bolts to prevent friction between leathers when joint is deformed by clutch withdrawal. 2—Pathfinder coupling with four arms to each flange and alternate bolting to leather disk. 3—Jeffery magneto coupling with differential holes in flanges bolted to leather to allow for fine magneto timing. 4—Standard form of coupling with leather ring between right angle flanges, provision being made for end play. 5—Willys-Knight clutch coupling with triple rawhide disks stiffened against end play of clutch throwout by spring support for leather. 6—National magneto coupling with leather inclosed for protection. Leather is attached to flanges A and B by bolts at right angles and the cupped edge of A overlaps the edge of B. 7—Modification of right angle flange coupling on Case. 8—Standard form of coupling as seen on Pierce-Arrow. 9—10—Kisselkar and Paige, respectively, are couplings with leather bolted to flanges. Bolt heads are free of holes in flanges and fair protection is given to leather. 11—Pratt coupling of similar type to 9 and 10, but in this case the bolt heads stand up in the holes in the flanges so that if the leather should fail contact will be made and drive maintained

The Rostrum



Why Have Sleds Narrow Treads?

EDITOR THE AUTOMOBILE:—I presume almost everyone knows that sleds used in the winter in this latitude have a 38-inch tread, while wagons, buggies and automobiles have a 54-inch tread. I would like very much to know why a sled for winter use should have a 38-inch instead of a 54-inch tread. If sleds were built with a 54-inch tread they would be a mutual help in keeping the roads open to automobiles as well as other vehicles. It is a well known fact to all physicians, for instance, that more sickness prevails during winter than during the summer, consequently we are obliged to use the roads more in winter than in summer. In these days of rapid transit, it is pretty tedious to have to resort to the horse for country service.

Why could not the automobile manufacturers of the country be enlisted to bring their influence to bear upon builders of sleds and point out to them the desirability of a standard 54-inch tread for northern latitudes?

Ann Arbor, Mich. JOHN A. WESINGER, M.D.

Communications

The editor of the Rostrum is anxious to secure from car users and others, communications dealing with the overcoming of difficulties, in making repairs and in the numberless other phases of every-day automobiling. This department is mutual and is a common ground upon which an interchange of ideas and opinions can be made as freely as in the clubroom.

The ingenuity of the motorist who has his own garage and enjoys working upon his car is originally responsible for many of the improvements made by manufacturers. In fact, it is known that every maker is more than anxious to learn the opinions of the users of cars and is more than anxious to benefit from the experience gained by the mass of automobilists.

Balancing Pistons and Connecting-Rods

EDITOR THE AUTOMOBILE:—Can you inform me where I can get scales or whatever is used to balance pistons so as to get them the same weight? I find that most engines have pistons and connecting-rods that weigh nearly twice what they should, especially in some of the older ones. Is there any rule as to how much of the piston should be above the piston pin and how much below?

2—I find that in a 4-inch bore pistons vary in length 1 1-2 inches. Some have nearly all the weight above the piston pin and more than one-half their length. Does not this sort of piston tend to cause piston slap and also knocking from having the spark slightly advanced too much.

3—Some cars seem to knock very easily from too much advance on the spark lever while others can be driven with the spark lever up to the limit all the time. One car I have in mind has rather long pistons and an offset crankshaft and it is impossible to make it knock by advancing the spark lever too much if the carbureter has the proper mixture, such a mixture as you would commonly use. Does not the long pistons have much to do in regard to piston slap?

Haverhill, Mass. DANA D. HINKSON.

—The pistons can be weighed on any scale and the weight noted and in this way balanced. It is generally customary to weigh the entire assembly, including the connecting-rod piston pin, piston, lower connecting-rod bearing cap and the bearing-cap bolts. If desired, these can be weighed upon an apothecary's scale and thus balanced. It is a general rule that the piston is placed about the center of the piston, although in many of the later designs it is near the top. No definite rule as to how much should be above and how much below has been adopted. The idea is, of course, to have the side thrust at the points of greatest connecting-rod angularity taken by as much bearing surface as possible.

2—The piston of the type you describe would seem to have the tendency to knock, due to the lack of balance about the piston pin.

3—Long pistons tend to eliminate slap because they get all the benefit of the greater bearing surface.

Meshing Drive Pinion and Crown Gear

Editor of THE AUTOMOBILE:—Kindly explain by sketch and description the proper way to mesh a driving pinion to the crown gear on a car that has no part of the housing cut away so you can see what you are doing.

N. Y. City. L. H. MANNING.

—The only way that we can suggest as practical would be to mesh the gears as nearly as possible by your sense of touch and then by holding one portion of the shaft, test the amount of back-lash by determining how much the rear wheel will rotate before the motion is transmitted through the teeth of the gears. There is no car, however, that we know of that has no part of the rear axle housing cut away to expose at least a small portion of these gears, without some arrangement at the forward end of the axle for making this mesh, and we would advise another examination of the axle before adopting the trial-and-error method suggested by minimizing the back-lash.

Increasing Stroke on Overland 69

Editor THE AUTOMOBILE:—I have a model 69 Overland and would like to put in a crankshaft for a 5-inch stroke. It has a 4 1-2-inch stroke at present. Can I use the same timing gears, crankshaft and crankcase with the added stroke by raising the cylinders higher?

Clermont, N. Y. ROYAL SAULPAUGH.

—The method you suggest would in no way increase the stroke but would simply tend to greatly lower the compression, which would not be desirable. The clearance in the crankcase of this model is not sufficient to admit of any increase in the length of the throws and it would therefore be impossible to increase the stroke without having a new crankshaft and a new crankcase.

Inquiries

¶ The purpose of the Rostrum department is primarily to aid in the solving of motorists' problems. Readers of THE AUTOMOBILE *are requested to allow our editorial staff aid in the solution of difficulties as they arise and perhaps through this assistance reduce the cost of upkeep of their cars and gain a useful knowledge in the economical phases of the vehicles which they use for recreation or business.*

¶ Answers are made both through the mails and through these columns, the only requirements being that the letters are legibly written on one side of the paper, and are accompanied by the name and address of the sender in order that they may be taken care of through the mails should that be deemed advisable. A nom de plume will be used should the sender so desire.

Strength of Tube and Rod Compared

EDITOR THE AUTOMOBILE:—Would you kindly publish in The Rostrum some information relative to the comparative strength, under bending stress, of seamless steel tubing and solid rod, compared diameter for diameter?

While realizing that the tubing is much stronger than the solid of same analysis and weight under bending stress, I am interested in their relative strengths compared as to diameter.

Del Mar, Cal. JOHN F. GRAY.

—The strengths of tubular and solid steel rods under bending stresses vary as the modulæ of their sections. The formula for the section modulus of a solid circular section is .0982 D^3. The formula for the section modulus of a hollow circle is $\frac{AD^2 - ad^2}{8D}$ in this formula A is the area of the circle bounded by the outside circumference and a is the area of the internal circle bounded by the interior diameter. D and d are respectively the diameters of the outside and inside circles. With these formulæ the relative bending strength for any diameter of solid rod and seamless steel tubing can be figured. To give an example, let us compare a solid rod having a diameter of 1 inch with a tubular section having the same diameter with the thickness of the tube 1-8-inch. The strength of the solid sectioned bar will be to the strength of the hollow section as the modulus of a solid section is to the modulus of a hollow section, as determined by the formulæ above stated.

Substituting in the formula, we find that the modulus of the solid section 1 inch in diameter is .0982.

Substituting in the formula, we find that the modulus of the hollow section 1 inch in outside diameter and .75 inch in interior diameter is 0671; therefore, the strength of the solid section is to the strength of the hollow section for the dimensions as given above, as .0982 to .0671.

In other words, for the conditions assumed the solid section is 1.46 times as strong as the hollow section. It must be remembered that where the benefits of the hollow section come in, are on a weight for weight basis and not on a diameter basis.

Mending a Mohair Top

Editor THE AUTOMOBILE:—Having watched carefully the questions and answers in The Rostrum, I have not seen anything about mending tops. I have a silk mohair top that has several small holes in it and it is so nearly new I would like to find some way of mending it.

Athol, Mass. SUBSCRIBER.

—The only way to mend a piece of mohair such as is used in an automobile top is by patching and it is very doubtful if this will be successful if the holes are all the way through. It would seem that, if the top is nearly new, the top manufacturer should be advised and if your claim is just he will no doubt make good on the material.

The patching is done by cutting out a piece of mohair large enough to fit over the hole and putting it on with tailor's glue or rubber cement. If it is a case where the outside only is chafed and the backing is still good, a piece of mohair with a rubber coating on the back, but without any drill used on same could probably be used to advantage. It would be necessary for the rubber coating to be uncured and then with a little naphtha or gasoline the mohair can be softened so that it will firmly adhere to the backing.

An Anti-Freezing Mixture

Editor THE AUTOMOBILE:—For the benefit of those desiring an efficient anti-freezing mixture for radiators please publish the following:

Denatured alcohol	1 gallon	Boiling point 180 degrees
Sorghum on syrup made of sugar (granulated), 8 pounds, and enough water to make a gallon	1 gallon	Boiling point 230 degrees
Water	1 gallon	Boiling point 212 degrees
		622 degrees
Divided by 3 will give an average of		207 degrees

This will give you 3 gallons of anti-freezing mixture for about $1.25.

This is a cheap mixture and is good for 20 degrees below zero to 25 degrees below zero. For colder take more syrup and more alcohol as required.

Rushville, Ill. DR. F. MOENCH.

Information on Spring Wheels

Editor THE AUTOMOBILE:—1—Is there being manufactured a wheel for automobiles that, by use of springs or other devices, makes it unnecessary that the wheel be equipped with either pneumatic or solid rubber tire?

2—If no such wheel is being made, can you advise if any patents have been issued covering such a wheel?

El Paso, Tex. S. A. WOODRUFF.

—1—There are many of these devices on the market.

2—Almost every issue of the *Weekly Patent Gazette* includes several patents covering spring wheels.

Horsepower, Displacement and Rivets

Editor THE AUTOMOBILE:—Will you please tell me the horsepower of a four-cycle, four-cylinder motor 3.375 by 4.75 inches and what would the piston displacement be?

2—The horsepower of a motor 3 5/16 by 4 3/16? What would the piston displacement be?

3—Would a good iron rivet be suitable to rivet a front cross member to the frame on a light car, or should it be put on with steel rivets?

Metz, W. Va. SUBSCRIBER.

—1—The S. A. E. rating of a four-cylinder four-cycle 3.375 by 4.75-inch motor is 18.21 horsepower. The actual horsepower output would perhaps vary from this, due to the individual design of the motor. This, however, is a good approximate formula. The piston displacement is 170 cubic inches.

2—Horsepower, 17.57; piston displacement, 144.3 cubic inches.

3—Good iron rivets would be suitable to use on the frame of a light car. The principal stress endured by these rivets is one of sheer through the tendency to wrack on the part of the frame. A great deal depends upon the manner in which the riveting is done. For instance, it has been shown in experimenting that a rivet is 6.5 per cent. weaker in a drilled hole than in a punched hole and that, by rounding the edge of the rivet hole, the apparent sheering resistance is increased 12 per cent. It is also true that sheering re-

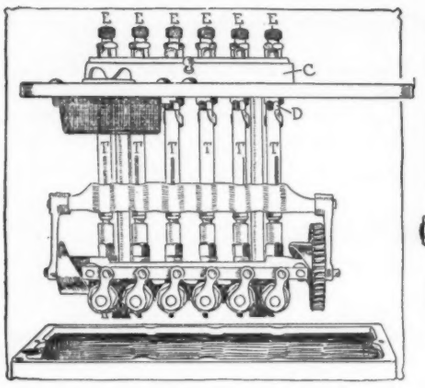


Fig. 1—Disassembled view of Lavigne oiler as used in Stevens-Duryea 1911 cars

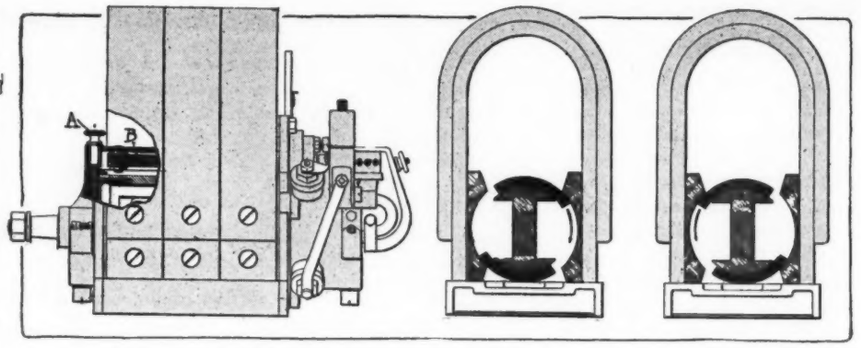


Fig. 2—Diagrammatic illustrations of the Bosch model HDh magneto, showing the parts which it is necessary to remove in performing the operation of re-timing and also showing the armature in its correct position for full retard with the cylinder about to fire on upper dead center. This indicates the correct setting

sistance is probably less for double than for single sheer, and this is probably due to the unequal distribution of the stress on the two rivet sections. Experiments on the sheering strengths of iron and steel rivets would indicate that the proportion of iron to steel is as 19 to 22.1. This ratio is said to be valid only if the sheer is in a plane perpendicular to the direction of rolling, which would be approximately the case in your cross-frame connection.

Carbureter and Oiling of Stevens-Duryea

Editor THE AUTOMOBILE:—Please describe the carbureter and oiling system on the Stevens-Duryea 1911 model

Elmhurst L. I. GEORGE W. GAY.

—The model AA carbureter used on the Stevens-Duryea 1911 model is illustrated in Fig. 3. The gasoline is fed through the pipe A into the float chamber B and has a level in this chamber sufficiently high to cause a suction in starting the motor to readily draw the gasoline through the nozzle C. This is the primary jet of the carbureter and the source of mixture at low motor speed. When the motor speed increases the air is drawn through the auxiliary air valve at D, giving the leaner mixture for high speed. This gives the bare principle upon which the carbureter operates and a study of the adjustments and connections will show how these principles are utilized to meet different conditions.

In adjusting the carbureter the lock nut E is loosened and the screw F turned to the right until it is closed; the screw G is then loosened slightly and the screw H is turned to the right until the needle valve C just seats. Only light pressure should be used as otherwise the part J would be forced down, allowing the auxiliary valve at D to open. The part K is then locked firmly in position by turning the screw G to the right.

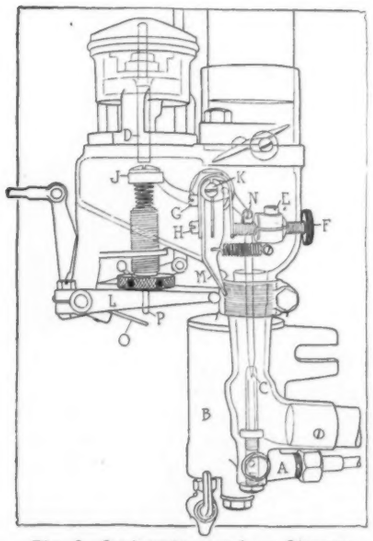


Fig. 3—Carbureter used on Stevens-Duryea 1911 model

The screw F is turned to the left about two and a half turns to open it and the motor is ready to start. In cold weather the lever on the dash should be turned to the central position of the quadrant in starting and after the start is made it is turned to the extreme right. When the lever is at the central position in the quadrant on the dash the carbureter should be acting as follows:

The lever L is in contact with the lower end of the part K at M, thus opening the needle valve G through the motion of the bell crank lever connected at K and attached to the needle valve G at the point N. At the same time the spring O is contacting with the pin P, closing the auxiliary valve D by forcing against it the part J.

To prime the carbureter before starting, there is a button to the right of the starting crank and after this is pressed the motor will start on revolving the crank. To make the remaining running adjustment retard the spark, close the throttle lever on the steering post and turn the screw F to the right until the motor runs unevenly, then keep turning it to the left until the motor shows the best throttling speed. If the carbureter pops when the throttle is opened quickly with the car running slowly under a load open the screw F for more gasoline, or if this has been turned to the left, more than 2¼ turns, turn the screw Q to the right to increase the tension on the part J. This will give the fundamental adjustments and beyond this point you can determine what further adjustments to make while on the road.

The oiler used is the Lavigne, Fig. 1. It can be adjusted to increase the speed of the oil, if desired. The shell D on each of the tubes T has a hexagonal shape to permit of the use of a wrench. To increase the amount of oil delivered this is turned to the right and to decrease to the left. This regulates the stroke of the plungers and any one may be set from zero to full stroke without in any way interfering with the operation of the other plungers.

Corresponding with each plunger is bleeder valve used to test the oil delivery. If at any time it is desired to note the amount of oil delivered, the slide C is opened and the bleeder valve cap E is pressed down, causing the oil to drop from the bleeder valve nozzle into the tank. The plungers should be adjusted to give about two drops of oil on each downward stroke. The method of operation of the plungers is clearly shown in the accompanying illustration, Fig. 1.

Timing a High-Tension Magneto

Editor THE AUTOMOBILE:—I would like to know how to time my Bosch high-tension magneto, No. 200,083, type HDh model 1908. It seems to be all right in every way but this.

Chittenden, Vt. JOSEPH E. CRAPO.

—To time your model HDh Bosch magneto, the magneto should be secured in position on the engine with its driving gear or coupling loose on the shaft. The screw A and the condenser B should then be removed in order to make the rotating sleeve accessible.

On two of the four longitudinal edges of the sleeve will be found notches similar to the notch on a knife blade, one

marked L and the other marked R, indicating respectively left or anti-clock-wise rotation and right or clock-wise rotation. The direction of rotation of the magneto is indicated by an arrow stamped on the end plate at the shaft end.

The sleeve should be rotated to bring the corresponding notch uppermost. The engine should then be cranked to bring one of the pistons, preferably that on cylinder No. 1 on top center, and with the crankshaft held in that position the magneto should be rotated to bring the sleeve into the position shown in the respective diagram, Fig. 2. The arrows indicate the direction of rotation when the magneto is viewed from the shaft end and the clearance between the pole piece and armature in figures should be from 8 to 10 millimeters. This is from .3149 to .3937 inch.

When the sleeve is in the proper position the gear or coupling on the driving shaft should be securely tightened, care being taken to prevent the movement of the sleeve during this operation.

The notch in the sleeve serves also to indicate the position of the distributer segments. The distributer brush holder which corresponds with the notch set into the stated position is therefore to be connected with the spark plug of the cylinder, which is on dead center and represents the first cylinder to fire. The cylinder next to fire is connected with the adjoining distributer brush in the direction of rotation of the magneto, etc. The firing order must be determined, therefore, before these connections are made. After the magneto is set and connected the condenser B is to be replaced and tightened by means of the screw A.

Horsepower of Two Motors

Editor THE AUTOMOBILE:—1—How many horsepower has a four-cylinder motor with 3 1-2-inch bore and 5 1-8-inch stroke according to the S.A.E. horsepower rating?

2—How many horsepower has a four-cylinder motor with 4⅛-inch bore and 4½-inch stroke according to the S.A.E. rating?

Carver, Minn. EDWIN HURTIG.

—1—By the S.A.E. rating this motor has 19.61 horsepower.

2—27.20 horsepower.

The Meaning of Torque

Editor THE AUTOMOBILE:—What is meant by drop forgings?

2—What does A.A.A. stand for?

3—What is the meaning of the word torque?

4—How is cylinder displacement figured?

5—Last year at the race meet at Binghamton, N. Y., between Lincoln Beachey and Barney Oldfield, a Binghamton daily commented on the races and said that Oldfield's racer, the Chintz, was 300 horsepower and that his Stutz and Fiat were 250 horsepower, each having only four cylinders. How can they develop such great horsepower?

Harperville, N. Y. C. W. BONNY.

—Drop forgings are parts which have been made by the drop forging process which incorporates a die in a falling weight. The die strikes upon the heated metal which rests upon the bed-plate of the drop forging machine and the impression carried by the die is transmitted by the impact to the heated metal.

2—A.A.A. stands for the American Automobile Assn.

3—The meaning of the word torque is tangential turning effort. It is generally applied in automobile engineering to the force which tends to rotate the crankshaft. It is given in foot-pounds and is the product of the effort in pounds times the radius or turning arm in feet.

4—The cylinder displacement is figured by multiplying the cross sectional area of the cylinder by the length of the stroke and then by the number of cylinders.

5—The fact that certain motors have only four cylinders would not prevent them from developing 300 horsepower or 250 horsepower. If operated at extremely high speed, with their large bore and stroke it would not render such a performance impossible.

Why Wristpin Seized in Bushing

Editor THE AUTOMOBILE:—We are sending you a wristpin and bushing of a motor which we are now overhauling. Upon removing cylinder block we noted that two of the pins were turning in their pistons instead of connecting-rod bushings. We annealed the pins, bored and sawed same, but still we could not press out pins, so we are compelled to break pistons. You will note that the pin and bushing is not scored but seem to be welded in one small spot. As the writer is a constant reader of your magazine he would like to have you explain same in The Rostrum of THE AUTOMOBILE. The bluish color of pin and bushing came from annealing them.

Freehold, N. J. CENTRAL GARAGE.

—On examination the piece sent in would appear to show that the wristpin had a flaw in the metal, due to the presence of some foreign material that flaked off under the influence of the heat due to seizing. A portion of the part torn away and which became welded to the upper connecting-rod bushing shows that it had never had good contact with the remaining part of the wristpin; that is, this metal, while smooth in exterior, really had an internal crack or flaw which developed at the time of seizing. The welding action is very peculiar in that it would seem to indicate that the foreign substance present was such as to render welding easier at that point than at any other, as there is no indication of scoring or adhering at any other point on the wristpin.

Stutz Racer Is Semi-Stock

Editor THE AUTOMOBILE:—Is the Stutz racing car a stock car or is it a special makeup for the purpose?

2—What is the gear ratio?

3—Which car do they use of the fours?

Nevada, Ia. HARLAND HARRIS.

—The cars used by the Stutz company for racing are semi-stock jobs, that is, they are stock cars which have been specially prepared for racing.

2—The gear ratios are altered to best accord with the track and road conditions.

3—The four-cylinder motor generally used has been the Stutz 40 which has 4.75 by 5 T-head cylinders giving a piston displacement of 389.9.

Chemicals in Fuel Injure Motor

Editor THE AUTOMOBILE:—I would like to know what I can put into gasoline to secure more power?

Salon, Ia. VICTOR O. HYNEK.

—THE AUTOMOBILE emphatically wishes to discourage the use of chemicals added to the gasoline because they are almost invariably detrimental to the motor.

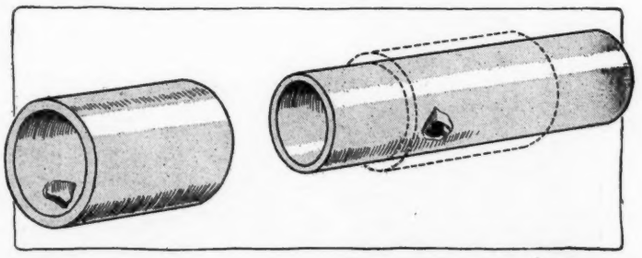
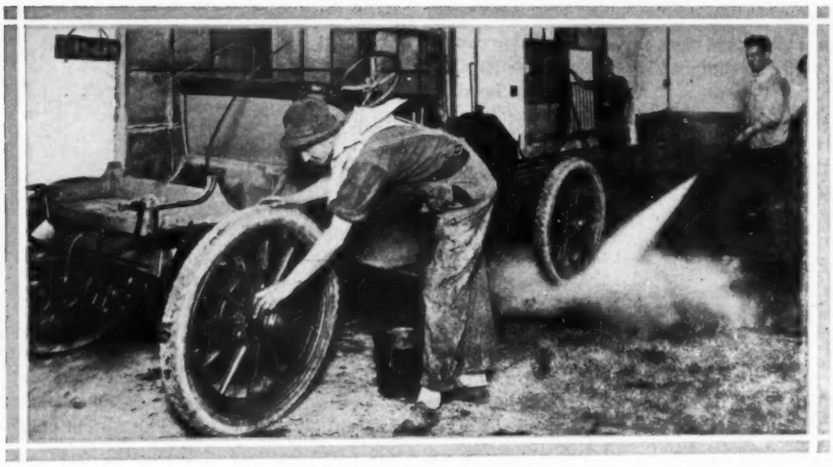


Fig. 4—Wristpin and upper connecting-rod bearing bushing, showing how these two parts were welded together in one spot due to a seizing action from lack of oil



First step in painting a car by the Radio process. Using the steam cleaning apparatus for cutting away the grease

Radio Process Japans a Car in 3 Days

Entire Car Placed in Oven, Drying 3-Day Varnish in 3 Hours

A DIRECT effort to give more efficient service to car owners who desire to refinish their vehicles has been made by the Fickling Enameling Corp., Long Island City. The process used has been named the Radio by this concern and by it complete automobiles can be japanned in 3 days.

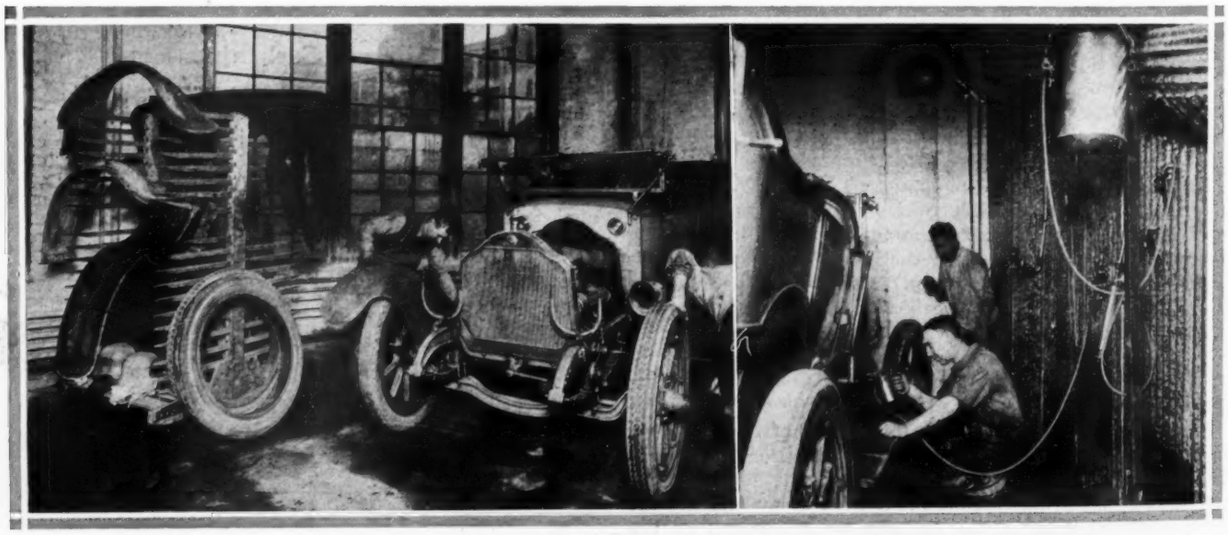
The theory upon which this new company is operating is that the average car owner often allows the painting of his car to go undone because he does not wish to be without his automobile for 2 or 3 weeks and at the same time does not believe in the economy of having a cheaper job done in a shorter time. This concern makes a specialty of quick-drying methods and by the use of up-to-date appliances cuts down the length of time spent in each process to the minimum.

When a car is driven in, it joins a group of others to make up a unit job in passing through the plant. The units are comprised of four or six cars which are taken in a single group and are put through the various processes together. The first operation is to clean the car and this is done by the use of a steam jet, which cuts away the grease and eliminates the rubbing which would be necessary by other methods. After all the grease has been removed, the fenders are taken off along with all the small parts which will require separate enameling. The other accessories of the car are placed on horses containing a large number of racks upon which the parts can be suspended and kept together. Thus, each job is divided at once into three units after the preliminary cleaning has been completed. The first unit is the body of the car and that part which requires repainting. The second unit is formed of he small parts to be enameled, such as the mudguards, lamps, fenders, engine hoods, etc. The third unit is the accessories which do not require either enameling or painting and which are placed upon the horse rack and rolled into a long line of similar horses there to await the time when they are to be reassembled upon the car.

The car proper and the small parts which require enameling have reached the parting of the ways, so far as the painting processes are concerned, when they are disassembled.

As a general rule, the paint does not have to be removed down to the bare surface of the body but merely has to be rubbed down and filled after the cleaning has been completed. The filling brings the surface to a level and smooth condition and it is ready for its first coat of paint. This is a coat of color paint and forms the primary foundation. When this coat has become dry a coat of colored varnish is applied which is afterwards rubbed down and finally the finishing coat of varnish is applied.

This corresponds exactly to what would be done in the ordinary paint shop so far as the general details are concerned. It is in the method of application and drying that the Radio process is claimed to save time and give a greater



Left—Removing the fenders and placing them on the rack. Right—Blowing the paint on with a paint gun

efficiency than is possible with the ordinary brush method. The paint, instead of being applied by brush is put on with a gun which in appearance resembles an automatic pistol, being operated by a trigger, held by a pistol-shaped handle and with the paint spray issuing from what would correspond to the gun barrel. The gun is a mixing chamber for air and paint, the result being that the paint is atomized and can be directed against the work in the same manner as with the ordinary air brush. This cuts the time of applying the paint and results not only in a more economical use of the paint itself, but is of great aid in applying the paint.

Entire Car in Large Oven

After the color varnish coat has been applied and rubbed down to a smooth surface, the entire car is placed in an enormous oven measuring 42 feet in length and 19 feet, 6 inches in width, and allowed to dry. The temperature in this oven is 110 to 120 degrees with 90 to 100 degrees of humidity, and the air is renewed in this oven every 3 minutes, by means of an exhausting fan. In this oven it is possible to take care of six large cars every 3 hours. During this time the varnish coat is completely dried and rendered hard. After being rubbed down the finishing coat of varnish is applied in another oven or finishing room where the temperature is from 90 to 100 degrees and the job is complete. The humidity here is 60 to 70 degrees, 30 degrees less than the temperature.

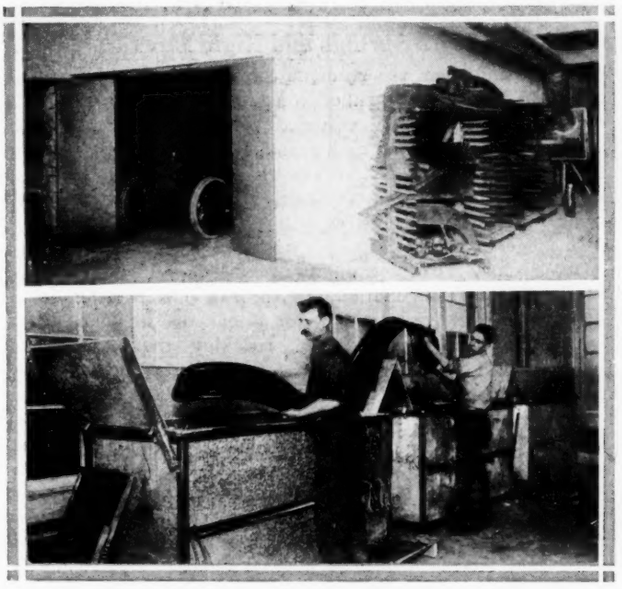
It is in the oven in which the color varnish coat is dried and hardened that the most radical departure from ordinary methods is made. The use of the high humidity and water-washed air keeps the exterior of the surface damp while drying the interior; thus instead of putting a hard shell over the soft layer of paint, it is dried throughout. When the exterior is dried, while the interior remains soft, the paint is apt to sweat through and discolor the finish. This is noticeable on engine hoods where the heat of the motor produces this sweating action rapidly and consequently results in a dulled finish.

Thermostatic control regulates the temperature in this oven and water control on a diaphragm regulates the humidity in this large oven. All the air which enters the oven is water-washed by running it through a water tank before it enters the oven. It is pumped into the oven by a fan blower and superheated by contact with radiator. The varnish which is dried in 3 hours is what is ordinarily known as a 3-day varnish and with the method of humidifying the air the general process where no humidity is employed is virtually reversed because with the dry air method the exterior is the first dry coat, whereas with the moist air the inside coat is first dried. With the outside coat dried first in the form of a hard shell it is stated that it requires about 3 or 4 months before the interior surface becomes absolutely dry.

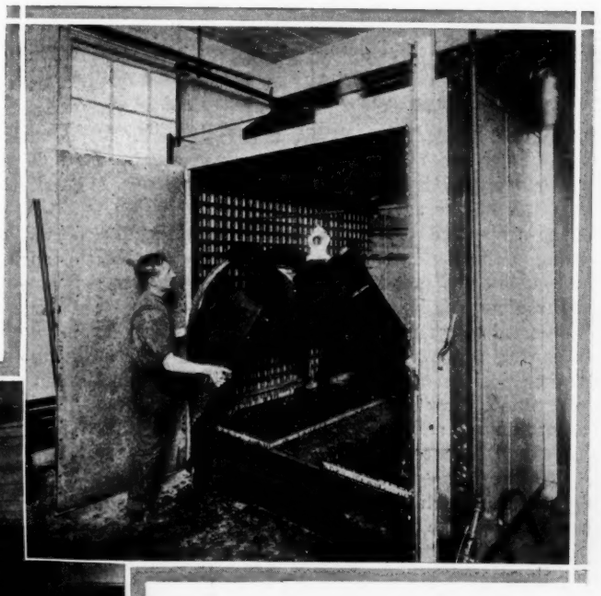
Besides the bare process, many precautions have to be taken and many accessories used in order not to have the entire work spoiled by overlooking a small necessary detail. The color varnish coat is applied in a varnish room where everything is kept tightly sealed against all possibility of the entrance of dust and the entrance to the oven is had without leaving this room, the oven itself being really a room within this outer varnish room. The entire floor upon which the various departments of the work are kept is cleaned every night by means of vacuum cleaners, and every cubic foot of air taken into these rooms passes through a water-filtering medium.

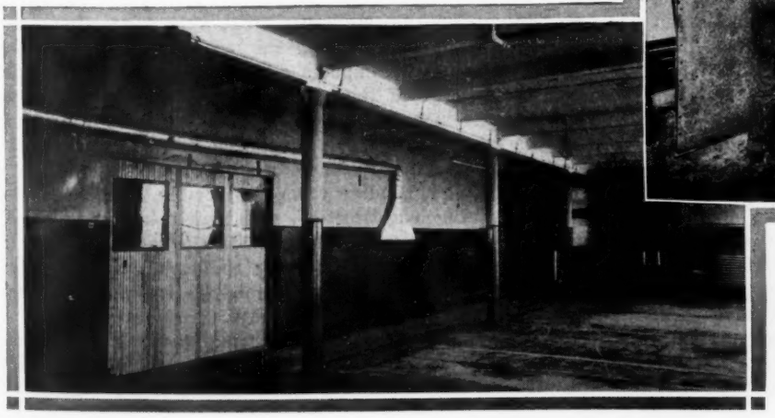
While the body and the chassis of the car have been going

(*Continued on page* 283)



Upper—Showing an entire car about to leave the oven, with accessory racks to the right
Lower—Dipping the fenders in the tanks of enamel. These receive three coats





Above—The steady heat oven in which the fenders and small parts are dried

Left—Finishing room, in which a dry heat is maintained for the finishing varnish coat

The Improvement of Spring Systems--VI

Magnitude of Forces Taking Effect Horizontally Shows Urgent Need of Cushioning So Far Neglected or Left to Air Tires

By M. C. K.

(2)—Movements and Shocks of Vehicles Equipped with Springs and Rigid Tires

IN passing from the studious contemplation of Figs. 9, 11 and 10 to the task of constructing curves of similar character for an assumed set of conditions, among which the use of hard and practically inelastic tires is one, and of adding the shock values which will come into play, it is evident from the outset that the first axle lift after the impact with the hard tires will be smaller than in Fig. 9 and larger than in Fig. 11, as the wheel will follow the obstacle closely to its summit, in accordance with the chart of springless vehicle action, Fig. 5, in a previous instalment, but will descend on the far side under the influence of the spring and gravity combined, reaching the level ground again much earlier than in the case of the springless vehicle where gravitation alone was acting. But it is also remembered that road obstacles which are in the nature of a short hill, Fig. 7, and admit of continuous rolling of the wheels before the obstacle is surmounted do not have the same effect as the kind of obstacle which has so far been mainly considered and, especially, are liable to cause the vehicle to leap, whether the tires are elastic or otherwise, after the summit of the obstacle is passed. Obstacles of this class are often looked upon as the typical comfort-destroyers, being exemplified in nearly every ordinary wave in road surfaces, and they must in fact be the only kind which those have in mind who assume a leap of the running gear after every shock. The movements of the vehicle should perhaps be plotted for this kind of obstacle, also, after the first kind has been disposed of and before proceeding to other specializations of the subject.

The Factors at Work

The factors deciding shocks and movements for a vehicle whose body and running-gear are connected by a single set of springs are, in addition to those so far considered, the flexibility of the springs, their resilience, the distribution of spring-suspended and unsuspended weights, the period of spring oscillation and the mechanical details of the spring system, but the last-mentioned factor relates to refinements rather than fundamentals and is ignored for the present. The period of spring oscillation, being the time elapsing while the spring swings freely from its position of equilibrium to another position and back to the position of equilibrium, is unfortunately a constant. It is found that the amplitude of the oscillation affects the elapsed time very little; so little that the difference can be ignored. On the other hand, the period is affected by the load, the flexibility and by retarding factors which set up frictional resistance to the spring movements. The retarding factors can reside in the metallurgical properties, which make the spring live or sluggish—and those which are sluggish generally take a permanent set sooner or later—in the friction between spring leaves or in friction in other parts of the vehicle which are subject to movement when the springs are working. It is found that in all vehicles, and especially in shaft-drive cars, the friction between leaves, even if they are many and thin, is much smaller than the aggregate of friction from other sources.

Probably the correct period of free spring oscillation, which is usually expressed in number of oscillations per minute, cannot be determined for any given set of conditions except by test and measurement. But to get an approximate picture of the vehicle movements which occur it is sufficient to assume the different factors to be of certain magnitudes which come somewhere near the conditions realized in actual vehicle construction. The flexibility may be taken as 1 inch deflection for 300 pounds of pressure (considering a pair of springs as one) for both front and rear springs (making the front spring action the less sensitive one, by reason of the smaller load, as usually desired with a view to better steering). The unsuspended rear weight may be 400 pounds with a load on the springs of 1,600 pounds, making a total rear weight of 2,000 pounds as in the case of the springless vehicle previously considered, and the unsuspended weight in front may be 200 pounds with a spring load of 800 pounds. The period of free oscillation—meaning an oscillation determined by the resiliency of the spring and not by the velocity of an external force acting with a push—may be 1/90 of a minute, but this may be modified when the spring imparts movement to the lighter running-gear as well as to the superimposed load, as happens when the wheels are off the ground. The efficiency of the springs with regard to their resilience may be 90 per cent.

With these assumed data an approximate course and time schedule for the vehicle and spring movements can be figured. But the very first thing observed in this connection leads to an important digression, as it is discovered that motor vehicles intended to be operated with tires of small yield and resiliency, mainly trucks and delivery wagons, are almost without exception built without a certain much needed spring element to take up horizontal shock.

The Horizontal Component of Shock Not Cushioned

Comparing the vehicle having springs with the springless vehicle it is noticed that they are both springless, practically, so far as horizontal shocks are concerned, as the springy elements work up and down only. There is even a trend among constructors for demanding that the movement imparted to the axles shall be as nearly as possible vertical, and to realize this effect flat springs are used and the front end of semi-elliptic and cantilever springs are lower than formerly. In the case of the front axle this serves mainly the purpose of safeguarding the steering action at the moments when severe impacts cause large spring oscillations, and in the case of the rear axle it reduces sliding motion in the universal joints of the drive shaft to a minimum besides permitting, if this is desired, the traction thrust to be transmitted to the frame wholly or partly through the springs, without bending them appreciably, as well as in the most advantageous direction, viz., nearly horizontally. But the need of keeping the front axle in the same vertical plane is not urgent when the steering rod moves transversely of the vehicle, instead of longitudinally, as it does now in most trucks and in very many small cars.

With large pneumatic tires to take up the horizontal component of a shock these provisions are doubtless based on thrifty reasons, especially for relatively light vehicles, but

in the case of heavy vehicles with tires affording very little yield the horizontal shocks are too severe to be neglected with impunity.

Magnitude of Neglected Forces

The horizontal component of BA, Fig. 5, was found in the case of the springless vehicle to amount to 8,524 footpounds, and the shock was concentrated largely in the beginning of the short pivotal movement of the axle around the road obstacle, so that the pressure in pounds at one moment would exceed this figure considerably, but it was understood that, on the other hand, the rotation of the wheel would cause a mitigation of this shock. The figures tentatively suggested were 5,269 footpounds transformed into tangential stress at the wheelrim and 3,255 footpounds reverting to the axle and there perhaps again subject to decomposition, but these figures were admittedly unsafe and subject to revision, it being plain, for example, that with the wheels stopped in their rotation for a moment by the impact the original figure of 8,524 footpounds—holding good for a fixed wheel—might come into force for that moment. At all events large forces, ranging perhaps under circumstances of no great apparent variation from 2,000 to 8,500 footpounds, with the corresponding pressures in pounds even higher, are suddenly applied horizontally against the moving structure when an obstacle of the shape and size here under consideration is encountered, and the shocks due to them are left uncushioned almost to the same degree in vehicles with the ordinary spring suspension as in springless vehicles. The numerous instances of broken radius rods which come to light, mostly with reference to trucks and omnibuses, testify to the practical importance of the omission and give indirect evidence to the effect that other damage which is more likely to escape immediate notice must be due to the same cause—perhaps especially damage to loads, to solid rubber tires and to springs and spring shackles.

Where full-elliptic springs are used a certain amount of cushioning for these shocks could take place, but not without subjecting the upper spring clips to immense stresses, and the axles in such vehicles are therefore uniformly prevented from moving horizontally by radius rods, and the advantage is thereby abandoned.

Many Designs Possible

A mere rearward movement, as is in some cases permitted the rear axle by having the front pivot of the radius rod—or the strongly curved spring—located considerably higher than the axle, does not in itself afford any appreciable relief for the shocks but could be made to do so if spring resistance acting especially against this rearward component of the axle movement were provided, which could be done in several obvious ways. And this form of relief might be acceptable (especially in conjunction with radius rods or springs capable of yielding horizontally to take up shocks received during reverse driving and to ease starting) even if the less important consideration of small sliding movement in universal joints had to be sacrificed. In the case of chain-drive vehicles the yielding point of the radius rod would perhaps have to be provided for in a different manner. The design will of course eventually be properly taken care of as soon as the necessity is realized.

Functions of Tires

In parenthesis it may be mentioned that no better reason probably exists for extending the use of air tires to heavy vehicles, in so far as practicable, than their great efficiency in absorbing horizontal shocks, while, on the other side of this question, a suitable provision for taking up these shocks in the spring suspension should make the use of solid rubber tires more acceptable and their virtues in the matter of reduced traction resistance more conspicuous. Elastic wheels, knotty as the problem of their construction remains, share of course with the air tire both the advantage and the disadvantage at these points, affording some relief for horizontal components of shocks but adding to the traction resistance on smooth ground through the continuity of their flexions.

In the case of solid rubber tires it is known that the yield which they afford does not exceed 1-2 inch in practice, their resistance to deformation increasing very rapidly beyond this limit, and their flexions on smooth ground are correspondingly small. They are mainly dampers of vibration and noise. While their action is slightly elastic under light loads and shocks, it comes nearer to the action of a perfectly rigid tire, so far as the vehicle and spring movements are concerned, than to any other action which could be appreciated in figures—though some data are available by test in this respect—and this action can therefore best be estimated as a modification of the shocks and movements to which the vehicle with springs and rigid tires is found to be subject.

The First Applicable Conclusion

Much emphasis is here laid upon the severity of horizontal shocks and the necessity for absorbing them more gradually than is done in practice, because this is the first conclusion definitely applicable to spring suspension practice which appears fully justified by the points so far brought out in these articles by going back to an examination of the first principles of spring suspension, in preference to following the custom of dwelling upon the refinements.

When all attempts to make the public accept pleasure cars in which a sensitive spring suspension and cushion tires were supposed by the makers to make air tires all but superfluous have so far failed, or have at least not met with pronounced

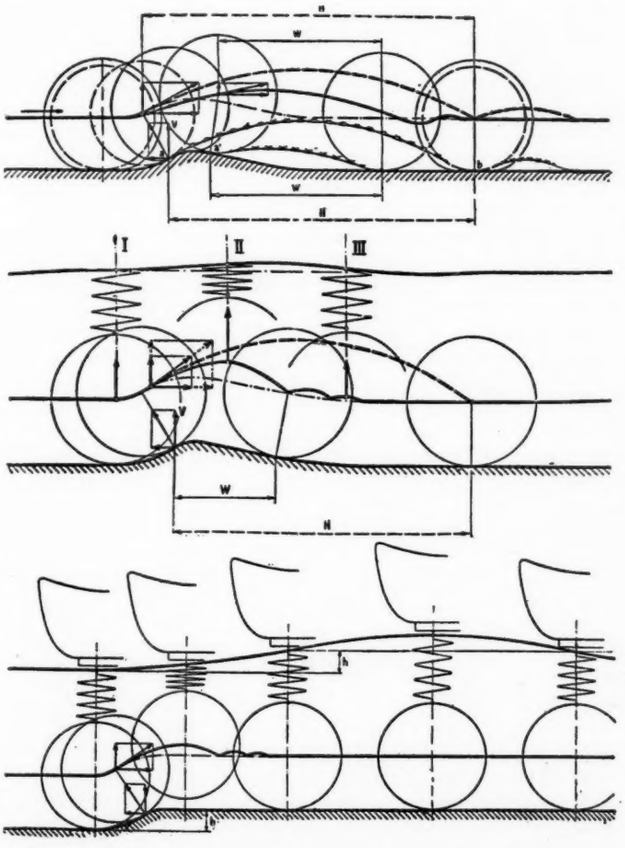


Fig. 12—Riedler's illustration of spring action. (1) Comparison of soft and hard tires. (2) Movements with hard tires. (3) Springs forced to raise body

success, this result may perhaps be ascribed not only to the public's aversion to schemes which might seem to imply a visible straining for economy but also to very actual shortcomings in the provisions for cushioning the horizontal shocks in such vehicles; and better provisions in this particular might change the situation somewhat. Whether the change would be desirable is another question, not to be discussed here at this moment, though it must always be well to remember, with a view to possible future developments, that the air tire, as we know it now, is less well adapted for small and light cars than for those of greater weight, because the inflation required for durability and that required for comfort agree better for the medium weights, and also that for still greater weights the practicability of the air tire is even now disputed on the ground of the liability to puncture and other lesions which comes into evidence when pressures reach certain figures at which the materials of air tires, and of solid rubber tires, too, are at the limit of the fiber stresses which they are fit to endure—conditions which, however, are liable to change as much in the future as they have already been changed for the better in the past.

Why Horizontal Shocks Are Tolerated

Some reasons why the need of cushioning especially for the horizontal shocks has so far escaped adequate attention in practice are more or less apparent. In the first place, the construction of trucks and delivery wagons, where such provisions are most needed, has been borrowed very largely from the construction of pleasure cars, and in these the horizontal shocks are taken care of partly by the air tires and partly in the footsoles and knee joints of the passengers, which are anatomically well adapted to absorb them with a fair degree of comfort, while for shocks arising from sudden accelerations, much milder than the retardations, both the air tires and the upholstered backs of the seats are active. In the copying, the air tires were replaced by solid ones, the reclining position of passengers by a more upright position and the soft seats by harder ones, but the revision of the spring suspension which should have come with these changes was neglected. Another factor is that the horizontal shocks become much milder in the case of the ordinary small obstacles encountered on a street or road, decreasing more rapidly than the height of the obstacle, so that the failure to provide especially for these shocks does not affect comfort so very strongly under the majority of conditions; and when such shocks are received they are therefore usually ascribed to some specially wretched condition of the road rather than to a shortcoming in construction. Nevertheless these shocks increase rapidly in frequency and severity on rough ground, and nearly all vehicles shod with solid tires have to negotiate such ground daily at certain times of the year if not all the year round. And in the matter of security, as distinguished from comfort, the exceptional shocks are, as before mentioned, almost as important as the ordinary ones.

A third factor explaining the omission lies in the fact that those who have analyzed the mechanics of a road shock have been content to accept the obstacle which affords a gradual ascent for the vehicle wheels as the typical one and the only one to be examined, while in reality nearly every obstacle partakes more or less of the characteristics of the obstacle whose mechanical effects have been made the basis for the first examination in these articles, this characteristic being the abruptly rising formation which causes some interference with the continuity in the rotation of the wheels and a momentary pivoting of the wheel around its point of impact, and thereby also a sharpening of the horizontal shock in a manner easily demonstrated. In an interesting popular analysis of spring action by Professor Riedler for example, which was reproduced in extract in THE AUTOMOBILE of April 17, 1913, page 846, this keen investigator drew all inferences, in so far as they were not drawn from practical driving experience, from the consideration of obstacles affording gradual ascent of the wheel and therefore paid little attention to horizontal components of the shocks. The illustrations used on that occasion are herewith reproduced as Fig. 12, as they bring aptly to mind how much the study of spring action has been engrossed in one side of the subject, being the complication of spring action with air tire action, and with one class of obstacles, which is the one that gives the largest vehicle movement when elastic tires are used and the speed is high.

Extract of Riedler's Views

That Professor Riedler's eyes were open, however, to the importance of cushioning the horizontal shocks—even if he had never analyzed the effects of the kind of obstacle producing them in highest degree—is plainly indicated in Report IX of his famous scientific work, *Wissenschaftliche Automobil-Wertung* (Scientific Automobile Valuation), where he takes occasion to describe and illustrate features of the spring suspension of Büssing commercial vehicles and omnibuses which at that time were the only German vehicles embodying provisions for mitigating the horizontal shocks, or at least some of these shocks. The principal features to which he refers are illustrated in Figs. 13 and 14. The remarks accompanying them give a clue to one of the most authoritative opinions which have been placed on record with regard to the requirements, and may therefore be reproduced here in substance. He says: "Elastic thrust rods acting also as chain adjusters transmit the traction thrust from the driving-wheel axle to the vehicle. Thereby the shocks of the tractive force (meaning the horizontal component of the whole shock) at the surmounting of obstacles, etc., is strongly reduced and the acceleration of the mass is effected gradually, with momentary storing of the kinetic energy in the thrust rod spring. This spring likewise results in saving the clutch at starts of the vehicle. During rough driving and at the starts the elastic effect of this spring actually makes a portion of the energy spent in the shock useful for propulsion immediately afterwards.

"Logically such springing is an intermediate step or organic part of the whole spring system, acting to

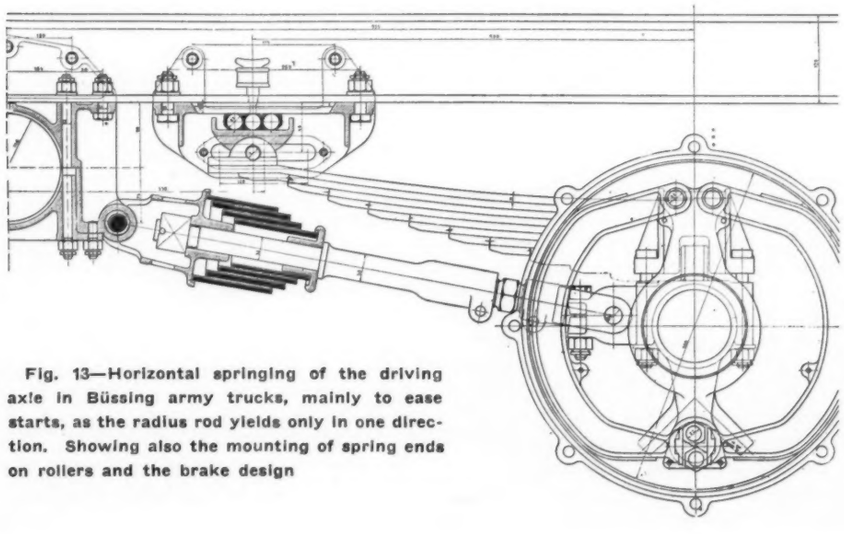


Fig. 13—Horizontal springing of the driving axle in Büssing army trucks, mainly to ease starts, as the radius rod yields only in one direction. Showing also the mounting of spring ends on rollers and the brake design

reduce the masses which come into action at shocks and saving the whole transmission mechanism.

"The effects of these elastic thrust rods and their necessity are shown even on the relatively smooth track of the testing station, which is more favorable than any ordinary street. The spring can also be made to serve as a dynamometer, and, connected with an indicator, could be made to give rough and yet valuable information about the forces at work during driving of the vehicle on difficult ground and at turns. Such observations would constitute a very desirable basis for more accurate examinations on the test stand."

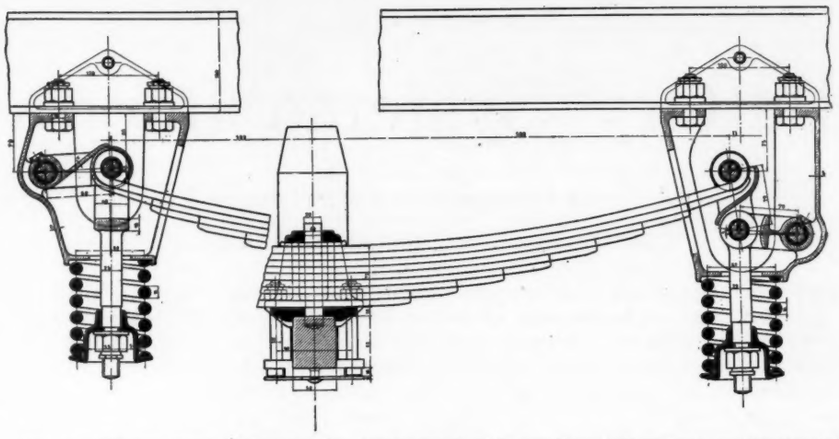


Fig. 14—Büssing front suspension for heavy truck with auxiliary coil springs and horizontal yielding

[Though Professor Riedler mentions the elastic radius rod of the Büssing vehicles as assisting in the allaying of horizontal shocks received in striking an obstacle, this seems to be mostly a theoretical remark as to what might be, as the drawing shows elastic action only in one direction, which would be of assistance only for accelerations, but not for retardations, unless the vehicle is driven backward.]

"The principle of the stepwise springing for all shocks is carried out in the Büssing vehicle, also in the double springing of the front axle, and this is applied to the rear axle, as well, in the case of omnibuses. The auxiliary coil springs absorb the small shocks which follow in too rapid succession for the slow-acting leaf springs. They increase the range of spring action and, provided they are hung and tensioned correctly, improve the whole suspension.

Subdivided Spring System

Professor Riedler dwells thereafter on the necessity for organizing the spring suspension throughout the whole vehicle structure, as it would be inconsistent with actual traffic conditions to look upon the frame or any other part of the structure in the light of a rigid machine foundation, but Fig. 14 is here shown mainly because the auxiliary coil springs, in the manner in which they are mounted and shackled, afford a limited chance for horizontal movement for the front axle against a spring resistance. He says further:

"It would be advisable to extend this principle of a subdivided spring system and yielding spring supports to pleasure cars, also, and not to be satisfied with the alleged suppleness of their structures, even though the smaller masses involved in their case makes the practical results of present methods more acceptable.

"In the Büssing vehicles the support of springs on rollers (see Fig. 13) avoids violence at these important points, reduces spring friction and secures undisturbed spring action in spite of any extraordinary dynamic effects which may occur during rough driving.

"The securing of the springs is in motor vehicles, generally, patterned after that used for vehicles drawn by horses. Such mounting by a pin and clips is unadapted for trucks and not particularly suitable for pleasure cars, as it does not withstand severe shocks. Many drivers have found this out at grade crossings of railways and otherwise in surmounting road obstacles. Better prototypes for correct design are found in locomotives."

In this last remark Professor Riedler refers plainly to the need of providing special spring action against the horizontal components of shocks, since these are the only forces which would be liable to break or loosen clips and pins.

This quotation of Professor Riedler's remarks on the subject is not meant to indicate otherwise an approval of the elaborate construction measures which he seems to favor, as the writer expects to demonstrate—or to come near demonstrating—that equally good and more economical results can be attained without impairing the constructive simplicity.

After this long digression based on the observation that the horizontal components of shocks, under the assumed set of conditions, are the same, or substantially the same, for vehicles provided with springs as for entireless springless vehicles, the examination should now proceed with the dissection of the vertical shocks and movements which have received so much more of practical and theoretical attention and do not present so obvious an opportunity for radical improvement.

(*To be continued.*)

—

Radio Process Japans a Car in 3 Days

(*Continued from page* 279)

through the process above described, the fenders and hood, together with the lamps or other parts to be enameled, have also been taken care of. After removal, the fenders and other parts are dipped in a steam-heated potash bath which removes all the dirt and former coats of enamel, leaving the metal bare and bright. Before going into the next process all the dents are taken out of the fenders and they are restored to their correct curvature and repaired to overcome the effects of rough usage. These smooth parts are dipped and taken into a separate room in which there are two ovens, one a flash oven in which a high temperature could be reached in a short time by a direct gas flame and the other a steady heat oven capable of handling the ordinary small parts as they come through from the dipping bath. The flash oven is only for quick special jobs.

The dipping process is in charge of a workman who has been imported from Manchester, Eng., the home of the enameling art. The large parts are dipped bodily into the enamel and after draining a few seconds are dried in the steady heat oven. Lamps and other small articles have the varnish applied by air brush. Three coats are given, the third being a transparent finish.

After the small parts have been finished and the body painting completed the two meet in the assembly department and everything is replaced. The cost of this work for a medium size, six-cylinder, five-passenger touring car in which the previous paint is in such condition that it can be rubbed down and refilled is $65. The paint has a mineral base. When wheels are refinished in natural wood they are dipped in acid and after 15 minutes a neutralizer is employed leaving the wood clean and white. They are then revarnished to give the natural wood finish.

Battery Systems Improved in Detail

Abrupt Separation of Primary Circuit Points with Elimination of Wear—Sparks Efficient Regardless of Motor Speed

THREE years ago when electric lighting and starting first began to be generally applied to cars of all prices, it was predicted by many that the addition of the generator for charging a storage battery would have a material effect on the ignition apparatus. This has been borne out. The announcements for 1915 show a marked increase in the use of the single battery ignition system.

While varying in details of construction, there is a general similarity between the various non-vibrating battery systems. They are all comprised of three units; primarily a combined timer and distributer which naturally falls into one instrument because the rotating shaft necessary for the timer can be readily employed as the shaft for the distributer. The second unit used is the coil for transforming the current from low tension to high tension. The third instrument is the switch. Besides being a mere device for turning the current on and off or of switching from battery to magneto or generator this device has been made to incorporate features which have eliminated the former objections to single spark battery ignition systems. In the Connecticut, for example, a thermostatic device is used for breaking the battery current when the motor is not in use, thereby removing the possibility of running down the battery. The Atwater Kent switch changes the polarity of the current every time the current is turned off. The Westinghouse system also uses a switch which changes its polarity. The Bosch switch can be placed in such a position that both magneto and battery are firing together, giving a two-point synchronized system.

In general, the non-vibrating battery ignition systems can be divided into two classes, those which work upon the closed, or break-and-make principle, and those which work upon the open, or make-and-break system. The fundamental difference in these two methods of operation is that on the closed circuit the contact points on the primary circuit breaker are in contact until the time arrives at which to break the circuit for the spark while on the open circuit when the time comes to produce the spark the primary contact is instantly made and broken.

This difference in the methods of reaching the same end gives rise to electrical and mechanical differences. The difference electrically is that on the closed circuit principle a long time is allowed for the primary circuit to become saturated and hence a great intensity is produced on the break. The theory of the open circuit is that contact is made and broken so rapidly that there is only a very short time in which the current is allowed to flow through the primary circuit and hence the curve consumption is very small. Both schools claim a hot, intense spark at the plugs, regardless of engine speed and regardless of timing advance, but it is in this primary difference of operating on the open or closed circuits that the systems differ electrically and also in the mechanical mechanism required to reach the desired electrical end.

Distributers Are Simple

The distributers are simple instruments in every installation. All have a quickly removable cover generally snapped on by a spring catch and in general the current is taken from a central point which is in connection with the high-tension coil terminal and distributed by means of a brush to each of the spark plug terminals. As a general rule, the current is not required to pass through a rubbing contact at the spark plug terminal points but instead to jump a small gap between the distributer brush and these spark plug terminal points. The reason for this is to eliminate the wear which would result from a rubbing contact.

The coils all comprise both the primary and high-tension windings. They are wound to meet the requirements of the open or closed circuit upon which they operate. Some of them are wound to take care of a current which falls to about one-half that of the 6-volt current generally used. This is for emergency in case of the necessity of operating on a nearly-discharged battery.

Waterproofing Is Complete

In common with magneto manufacturers, the makers of the battery ignition systems have realized the necessity for ample waterproofing. This is a simple matter in these systems, as the timer distributer is generally quite high in relation to the motor, the coil is generally placed at quite a height and the switch on the instrument board. In order to protect the timing mechanism and the distributer connections the housing for these points, which is always removable for inspection purposes, is of Bakelite or some other hard, durable substance. The terminal connections for the spark plug leads are taken through this hard cover by different systems of connections but which all have tightness and waterproofness as fundamental qualities.

Common aims on the part of the designers can be traced throughout all the battery systems. Whether the system be operated on the closed or open circuit principle, abruptness of separation of the primary contact point is one of the principal aims to which all are working. In the closed circuit system, such as the Connecticut employs, this is obtained by having the steep points on the cams strike the follower at a point on the breaker arm which is closer to the breaker arm fulcrum than are the points to be separated. In this way the speed at which the arm is moved at the point of the cam follower is magnified by the time it reaches the end of the arm at the breaker points. In other words, the end of the arm, by virtue of the greater radius, has to travel a greater distance in the same length of time than the follower and hence must travel at a greater speed.

Quick Action in Open Circuit Type

On the open circuit devices such as Atwater Kent, the making and breaking of contact is effected so quickly that the eye cannot follow its action. This is due to the arrangement by which contact is made and broken by the rapidly passing action of a hammer striking a spring. In all these breaker systems wear has been cut down by the use of glass-hard parts and by using the lightest possible moving masses.

Connecticut Is Closed-Circuit Type

The Connecticut ignition system, made by the Connecticut Telephone and Electric Co., Meriden, Conn., is a high-tension design comprising an interrupter and distributer unit, a coil and a switch. Both the interrupter-distributer and the switch are unique in many respects. The interrupter is so constructed that the primary circuit of the coil is caused to become com-

pletely saturated before the breaking point is reached and therefore a spark of maximum intensity is produced upon the interruption of this circuit. Another distinctive feature which is incorporated in the switch is that it is impossible for the battery to become discharged if the switch is left on because a thermostatically operated electro-magnet breaks the current by severing the connection between the battery and the coil should the switch be left on when the motor is not in use.

It is also claimed for this ignition system that both electrical and mechanical lag have been eliminated throughout the range of motor speeds, and the makers state that the eight-cylinder igniter will fire perfectly at a motor speed of 3,000 r.p.m. as well as at lowest possible engine speeds. This means that the igniter is capable of producing 12,000 sparks per minute or 200 sparks every second. The system is made for three, four, six and eight-cylinder motors.

The interrupter mechanism operates upon the closed circuit principle, the theory being that by this method the complete saturation of the primary winding is obtained. At the same time, it is claimed the mechanical and electrical lag are also eliminated, because the mechanism of the interrupter is only required to break the circuit when the spark is desired and not to make and break it.

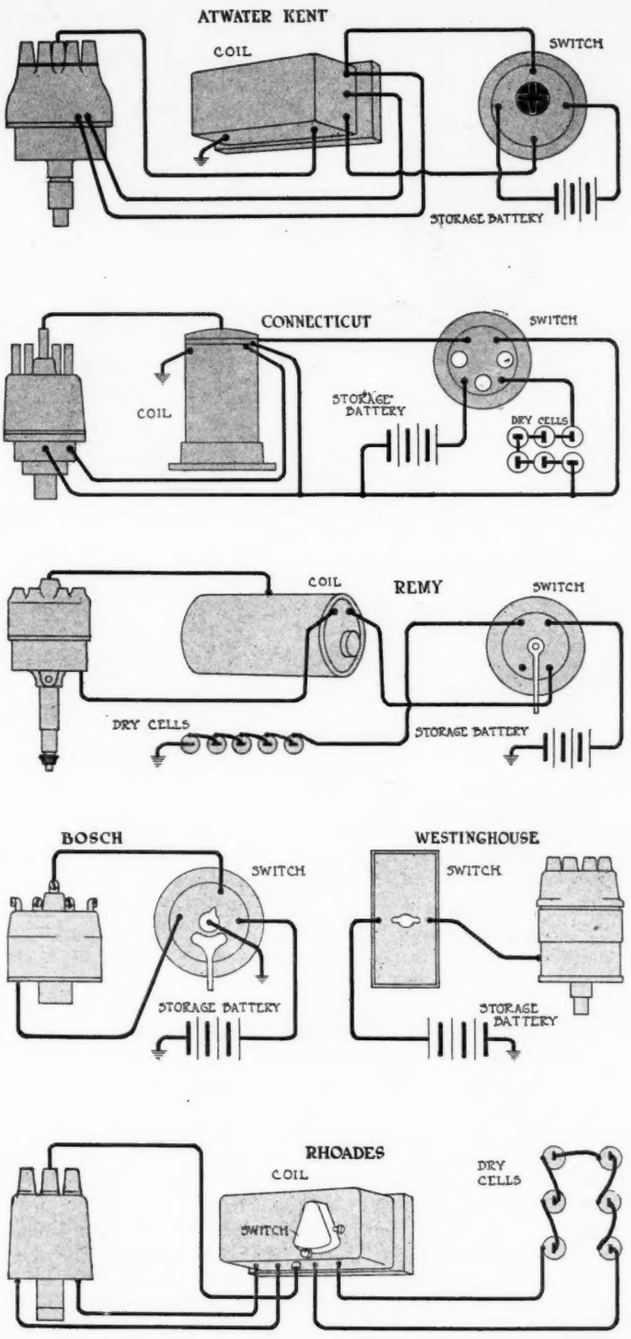
The mechanism of the breaker consists of an arm A carrying one contact piece, the stationary block B carrying the other contact, an insulated roller R, which is carried by the arm A, and the cam C which is mounted upon the driving shaft in the center. Upon the cam C there are as many points or high spots as there are cylinders on the motor. Normally the two contact points are held together by the action of a light spring upon the arm A. When one of the high spots corresponding to the firing point in one of the cylinders lifts the roller the circuit is broken and a spark produced. As the four cam spots for a four-cylinder motor are 90 degrees apart, the period of saturation of the primary or the length of time that the current flows to it from the battery is at a maximum. When the contacts are separated the current which has accumulated in saturating the primary is such that an intensely hot spark is given at the plugs.

Synchronism, or that quality of ignition which allows the spark to occur at the same relative part of the stroke, is obtained by the elimination of the electrical lag due to the intensity of the induced current. In other words, to all practical purposes, the spark occurs at the same position as regards piston travel regardless of the speed of the engine, for any given position of the spark lever.

The switch incorporates a feature that is an ingenious method for obviating the possibility of battery discharge if it should be left in the on position when the motor is not in use. Referring to the illustration, it will be seen that the switch incorporates a small thermostat which becomes heated by the battery current when the motor is not in use and when raised to the operating temperature it automatically operates the electro-magnet which, in turn, releases the switch button and throws out the battery circuit. The switch has three buttons, that labeled B is for the battery current, M for the magneto or generator when a lighting system is employed and a button labeled Off which, when pressed, throws either of the other two back to its original position. The three buttons are so arranged that when either the B or M button is pressed the other is thrown out and both cannot be pressed at the same time.

Circuit-Breaker Is in Switch

The thermostatic circuit-breaking mechanism is entirely housed within the switch. The method of operation is by utilizing the properties of the thermostat T, which becomes warm from the current of the battery and bends downward making contact with the contact point L. This completes an electric circuit which energizes the magnets M causing the arm K to operate like a bell hammer or buzzer arm. This arm drives against a plate which in turn releases the button in the switch which is depressed.

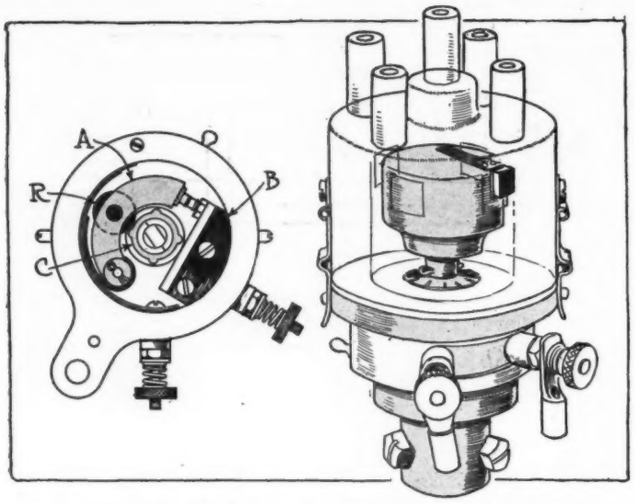


Wiring diagram of some of the leading battery ignition systems, showing method of connecting and grounding the circuits used by representative manufacturers

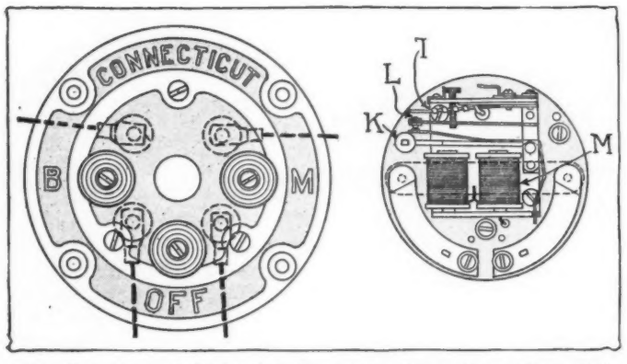
The distributer mechanism is conventional and is shown in the accompanying phantom drawing. The current is taken from the coil lead to the central point and then distributed by means of a brush to the high-tension terminals from where the current is taken on the high-tension lead directly to the spark plugs.

Atwater Kent Has Increased Advance

Only slight refinements in detail mark the Atwater Kent ignition system, made by the Atwater Kent Mfg. Works, Philadelphia, Pa., for 1915. Chief of these is an increase in



Breaker mechanism and timer-distributer used by the Connecticut company



Left—Exterior and Right, interior of the Connecticut thermostatically controlled switch

the speed range of the automatic spark advancing mechanism, to suit the growing tendency toward higher motor speeds. This improved type is now designed to advance the spark proportionately up to a motor speed of 24 r.p.m.

Other changes are the discontinuing of the old type F in favor of the later type H where manual advance is specified. The latter is also now supplied complete with attaching brackets for installation on Ford cars. The type K-2 which has automatic advance is also supplied for Fords.

The Atwater Kent system comprises a coil and a combined breaking and distributer mechanism with a switch for the control of these units. In the K-2 type a centrifugal governor automatically advances the spark in the proportionate ratio to the increase of motor speed. The system is complete in itself and will operate from any standard 6-volt battery. The system is made for four, six and eight-cylinder motors and the only moving part is the timer distributer which the Atwater Kent company has named the Unisparker. This is mounted on a vertical shaft after the general method employed in battery distributer practice.

Five objects are stated to be the aim of Atwater Kent ignition. They are: 1—uniform spark heat for all speeds; 2—automatic retards for safe guarding; 3—automatic advance along a regular curve; 4—unlimited advance and 5—elimination of wear.

By this system a single spark is delivered at the plug and the mechanism is such that the duration of current flow to the primary winding of the coil remains constant regardless of engine speed. Since the make and break mechanical system is positively operated and not dependent upon magnetism, it operates absolutely regardless of the battery condition. The contact maker makes and breaks contact once per each cylinder in turn. It operates by the rotating half-time shaft and the contact maker breaks as well as makes contact, no vibrator being used.

Circuit-Breaker Contact Brief

The circuit-breaker normally has its contact points held apart and they are brought together only for an exceedingly brief period during which the primary circuit is completed and broken. This action takes place so rapidly that it is impossible for the eye to follow the movement of the contact points. Since the circuit is closed at such a short period of time the amount of current consumed is naturally exceptionally small. Another feature is that it is impossible for the two points to remain in contact and hence the battery cannot be exhausted by leaving the switch in the on position when the motor is not running.

The shaft S which is the rotating portion of the breaker distributer mechanism has four, six or eight notches equally spaced peripherally according to the number of cylinders. The trigger T catches in these notches and is drawn around with the shaft a minute distance, when it escapes from the notch, rides up slightly on the round surface of the shaft and then returns to its normal position by the tension of the coil spring P. As the trigger T jumps back under the influence of the coil spring it strikes the hammer H which in turn transmits the blow to the flat spring F bringing the contact points together for a minute period of time. This gives the contact and breaks it in such a short space of time that the eye cannot follow the closing of the circuit by the contact of the points.

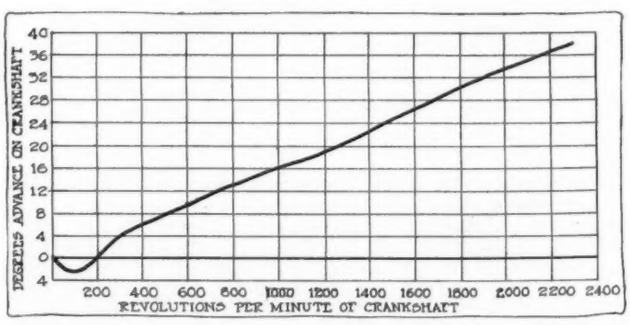
Hardened Steel for Rubbing Parts

All of the parts which are subject to a rubbing contact are made of hardened steel and since the moving parts are exceptionally light, wear should not make its appearance during the life of the car. The tungsten contact points are also well cared for in that the current is automatically reversed by the switch every time it is turned on. The adjustment of the contact points is effected by the removal of shims from beneath the head of adjusting screw which carries one of the platinum points.

As the contact is made and broken only during the time that the hammer H is in motion, it is impossible for the points to remain together and thus discharge the battery when the motor is not in use, as there is no possibility for the hammer to be held in the position that it occupies at the time it strikes the spring F, making and breaking the contact.

The distributer is a simple blade, insulated on top of the shaft, receiving current from a central contact and delivering it to the several pointed brass collectors in turn. Actual contact between the blade and the collector is not required, owing to the ability of the current to jump a small amount of gap at this point. By eliminating the contact, wear is avoided.

Manual advance, if required, is accomplished simply by



Curve of advance as given by the Atwater Kent centrifugal governor

rotating the case and the distributer. The type H relies wholly on this while the type K-2 which is most used puts the responsibility of the advance on the governor. The governing mechanism is obtained by four weights W distributed symetrically about the divided shaft; the upper half of the shaft carries the contact maker and distributer while the lower half carries the governor. As the weights W on the latter are thrown from the center, they rotate the upper shaft through a maximum arc of 38 degrees which is equivalent to 76 degrees on the crank circle as the distributer shaft is operated at one-half crankshaft speed. The weights are in balance and are controlled by springs so arranged as to exert an increasingly direct pull as the weights expand. The tendency of the weights to expand faster than the speed increases, due to the law that the centrifugal force varies as the velocity squared times the radius is counteracted. The resulting curve of advance is shown in the accompanying illustration.

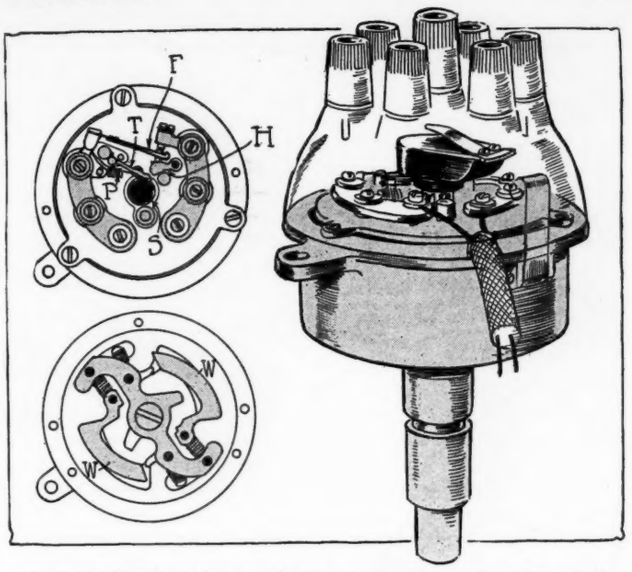
The switch is operated by a handle which continually rotates in a clockwise direction, turning the switch a quarter turn, switches the current off or on and at the same time reverses its polarity. A lock is provided in the form of a removable plug.

Westinghouse System Is Single Unit

The Westinghouse Electric and Mfg. Co., East Pittsburgh, Pa., has brought out a battery ignition system which is complete in itself and when operated in conjunction with the storage battery and generator generally supplied with the car, makes up the third unit of a complete starting, lighting and ignition system.

The distinguishing feature of the Westinghouse system is that the timer, distributer, coil and condenser are all in a single unit. Besides this, the switch comprises the sole remaining part. The three-in-one unit is designed to be vertically mounted and can be operated from the camshaft or any other suitable rotating medium by means of gear reduction. The casing is cylindrical in shape with a diameter of 3.25 inches and a height of 5 inches.

Referring to page 288, which shows the breaker mechanism, it will be noted that this is similar to other Westinghouse instruments except that it is not provided with automatic spark advance. The breaker operates on the close circuit principle, the contact point C and C1 normally being held together by a small coil spring S. This spring is under compression and holds the flat piece which carries a cam follower F. This flat piece is on a fulcrum keeping the two points tightly together. The cam L is mounted loosely on a shaft being turned by a pin P which comes against the stops A and B according to the direction of rotation. This permits the mechanism to work equally well in either direction. A backward travel of approximately 48 degrees is possible without causing the contacts to separate and induce a spark and a consequent backfire. In rotating the cam L engages with the fiber block F thus separating the contacts.

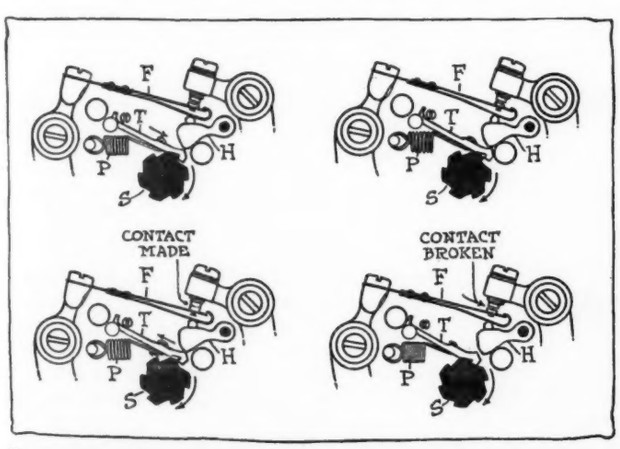


Atwater Kent breaker mechanism assembled and a view of the centrifugal governor, together with a phantom drawing of the engine timer distributer assembly

The condenser K is mounted adjacent to the breaker mechanism and in connection with it is placed below the coil which surmounts it. The entire unit is inclosed in a tube of Bakelized Micarta which forms the body of the unit. The coil itself is imbedded in a heat-proof insulating material. Over the lower parts of the Bakelite tube is a metal ring which can be moved upward after a screw is loosened to give access to the breaker mechanism. On page 288, which shows the Westinghouse unit, this ring is shown pushed up out of the way exposing the adjustment screw for the contact point.

The distributer for the high-tension current is mounted above the coil and being in conjunction with it no external wiring is necessary. It provides a wiping contact and is similar to the distributer used in Westinghouse generators. There are two round brushes which are held apart by a small coil spring. One of the brushes makes contact with the coil terminal at the center and the other has the wiping contact with the points which connect to the wires of the spark plugs.

The Westinghouse switch is another of those involving the change of polarity principle in prolonging the life of the contact points. It is a snap design generally mounted flush with the dash and combined with the lighting switches on the instrument plate. A kick-switch with a lever is also supplied when desired and in this the direction of current flow is determined by the manner in which the plug is inserted and thus it is often changed inadvertently.

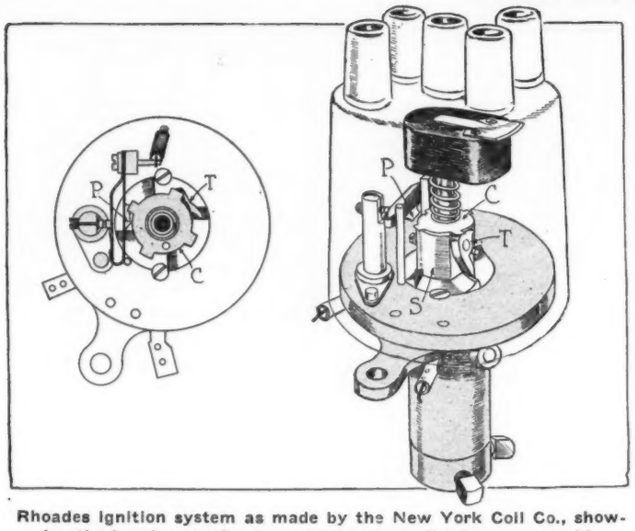


Progressive steps in the operation of the Atwater Kent circuit breaker which separates the primary contact points

Rhoades Comprises Two Units

The Rhoades unit spark system produced by the New York Coil Co., New York City, is a complete battery ignition system operated on a 6-volt storage battery or on the equivalent in dry cells. It can be made for any number of cylinders and connects to any desired shaft size.

The complete system comprises two units, one embodying the breaker and distributer mechanism and the other the coil and switch. The first-mentioned unit is contained in a 5.25 by 3-inch cylindrical housing, the lower part of which contains the breaker mechanism which operates on an ingenius open-circuit principle which renders it impossible to discharge the battery cells when the motor is not running.



Rhoades ignition system as made by the New York Coil Co., showing the breaker mechanism and the timer distributer assembly

This is effected by having the contact of the primary circuit made and broken by a hammer action which does not take place except when the timer shaft is revolving. This breaker mechanism is illustrated above.

The rotating shaft S has pivoted to it a trigger tripper T which revolves with the shaft and in its course slips over four cams in the base plate. As the trigger is raised by the cams it in turn raises a hammer plate C, which has four projections equally spaced around its circumference. For a six-cylinder car it would be six projections, and there would be six cams in the base plate. As the trigger is tripped the projection which is in the proper place strikes the contact spring P, making and breaking contact. The blow of the hammer plate C is rendered sharp by the action of the coil spring above it and the plate itself is prevented from turning by a pin in the shaft which acts as a guide retaining the plate always in the same position as regards the position of the shaft.

Contact is made and broken during the brief period of time required for the coil spring to bring the hammer plate down to its original position, and since the contact can only be made during the fall of the hammer plate, it is impossible for the contact points to remain together when the motor is not running.

With this method of breaking the current a single intense spark is produced at each interruption of the primary circuit of the non-vibrating coil, and since the primary current is only permitted to flow through the coil for a fraction of a second, the drain on the battery is practically negligible. The distributor is carried at the top of the verticle shaft of the breaker mechanism and gives a wiping contact at the center and at the periphery there is no rubbing contact since the spark jumps from the segment to the points which are connected to the high-tension terminals on the top of the housing.

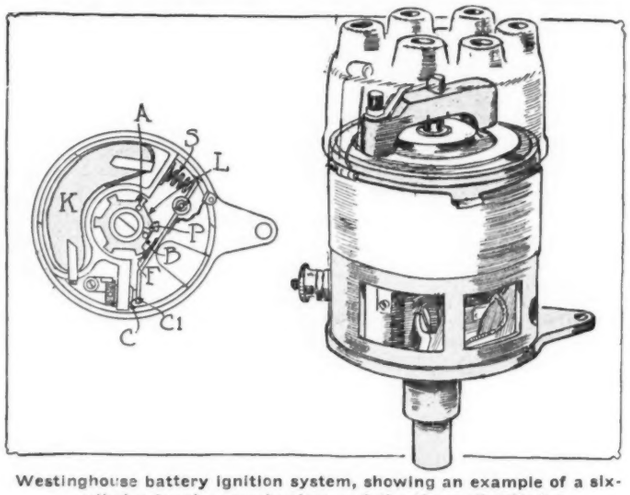
The other unit, which includes the coil and switch, is incased in a box to be mounted on the dash. It is of orthodox construction, the non-vibrating coil being designed to produce the maximum spark possible for the brief period of saturation of the primary coil. A kick-switch and a button for starting on the spark are mounted upon it. In addition to the standard system there is one which is produced especially for use on Ford cars. It uses the regular sparking apparatus and coil, but the outfit includes also all the necessary fittings for mounting this ignition system upon the Ford car.

Bosch Is Single Spark System

The Bosch Magneto Co., New York City, developed its battery system several years ago as part of the Bosch two-independent system. Ignition is permitted with this either by the magneto and one set of plugs, by the battery on a second set or by both operating in synchronism. The battery part of the system comprises the coil switch, lock and a timer distributer. The switch is incorporated in the coil and the timer distributer is also a single unit. The system operates on a 6-volt current and is used in connection with a storage battery. It is recommended that a 6-volt, 60-ampere hour capacity be used. If dry cells are used there should be ten for a four-cylinder motor and twelve for a six-cylinder, connected in series-multiple.

In mounting the Bosch system the coil is generally placed behind the dash with the switch projecting through the instrument board. The timer distributer is attached to a shaft operating at camshaft speed by means of a sleeve and a taper bolt.

The system is a single spark in which ignition is produced by a sudden breaking of the primary circuit. As is common with the single spark ignition systems, the high-tension distributer is mounted directly above the breaker mechanism in order to have the same shaft perform the dual function of timing the spark and distributing it. The breaker is worked out in a very simple manner as is shown on page 289. The rotating shaft A carries the cam C, which is designed to break the circuit as many times per revolution as there are cylinders on the motor. In the illustrated cam there are six points at which current interruption takes



Westinghouse battery ignition system, showing an example of a six-cylinder breaker mechanism and the timer distributer

place, since it is designed for a six-cylinder motor. One contact point is mounted on the fixed block B, and the other is on the movable arm M. The spring S controls the action of the movable arm. As the cam rotates it bears against the fiber follower piece F, thus separating the points at each high spot on the cam.

The high-tension distributer consists of a radial arm carrying a carbon brush, which makes successive contact with a number of contact pieces inserted in the sides of the casing. These connect to the lead which go to the various spark plugs.

There are four points on the switch, lettered O.B, MB and M. In the O position the battery circuit is broken and the magneto is grounded. When the switch is thrown to position B, the magneto is still grounded but the battery circuit is completed, and in consequence the breaking of the circuit by the timer distributer will result in the production of a spark that will be transmitted to the proper cylinders by the distributer. In position MB both the magneto and battery are producing sparks and in position M the battery circuit is broken and the magneto alone is in operation.

A button located in the coil end plate will produce a spark in the cylinder that is on the power stroke. With the engine

in normal condition a light and momentary pressure on the button will cause ignition, but should the mixture be poor in quality or the motor stiff, it will be necessary to crank. With the switch in the B position cranking will produce a single contact spark on the breaking of the battery timing. Under conditions that make the mixture difficult to ignite there is a vibrator provided which may be locked in position by pressing down the button and rotating it slightly to the right. The motor is then cranked, vibrator sparks will be produced, instead of a single spark, which will tend to facilitate starting.

Remy Consists of Three Units

The Remy Electric Co., Anderson, Ind., has developed a system of battery ignition which it has designated the model 100 magneto type battery ignition system. It is intended for use on cars that are equipped with electric starting and lighting systems, and can be operated on either a 6 or 12-volt circuit. The system is divided into three units, a timer distributer, a coil and a switch. The timer distributer is mounted on any convenient shaft driven at 1-2 crankshaft speed, the coil can be located at any convenient position and the switch is generally placed on the dash.

Simplicity and lightness are features of the breaker mechanism, which is a closed circuit design. The rotating half-time shaft carries with it a cam which has as many faces as there are cylinders. Below this cam C is shown in connection with the follower F, against which it bears in rotating. The follower is fiber and when acted upon separates the contact points, one of which is carried by the movable arm A and the other is located on the ends of an adjusting screw which passes through the thick block B. The two-contact points are normally held in a closed position by the coil spring S which holds the arm A. With this mechanism, as the shaft rotates, the contact between the primary points is broken each time a high spot on the cam comes in contact with the fiber follower, thus producing a high-tension spark.

The distributer mechanism is mounted in the same unit above the breaker and consists of a radial arm keyed to the rotating shaft with a simple spring contact bearing against a carbon contact piece imbedded in the Bakelite distributer cover. There is a gap between the distributer points and the arm which the high-tension spark jumps on its way to the terminals and thence to the spark plugs. By leaving the gap between the distributer on the high-tension terminal point wear is eliminated, since there is no metallic contact and the life of the instrument is correspondingly increased.

The Remy battery ignition system differs from others in that the advance and retard mechanism is entirely separate from the distributer cover. When the timing lever is moved the cover remains stationary, obviating the necessity for moving the wires and avoiding the possibility of chafing the wires and causing leakage in the high-tension current.

The coil is designed to produce a spark on as low a voltage as 2.5 for a 6-volt system, and therefore, should the battery become nearly discharged, a spark will still be produced which will be sufficient for ignition purposes. The dimensions of the coil are not great, as it is a cylinder 2.75 inches in diameter by 4.25 inches in height. The condenser is a part of this unit and is fully inclosed.

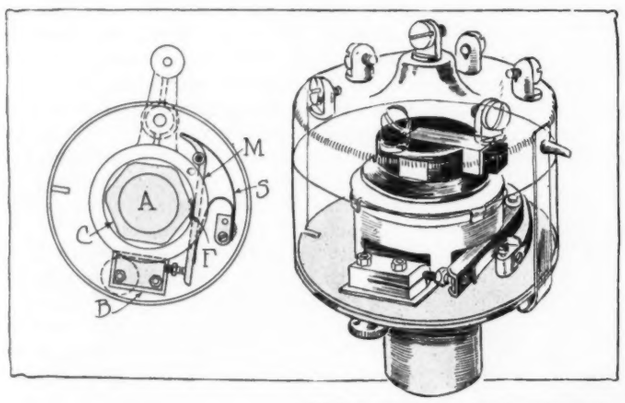
The switch is a three-point design lettered M, O and B, or, respectively, Magneto, Off and Battery. The lever can be locked in the off position and the key is removable. The distributer is intended to be mounted to rotate in a predetermined direction. The only change necessary for a change in the rotative direction of the shaft is the reversal of the distributer segment, which is marked with an arrow to show the preferred direction of rotation.

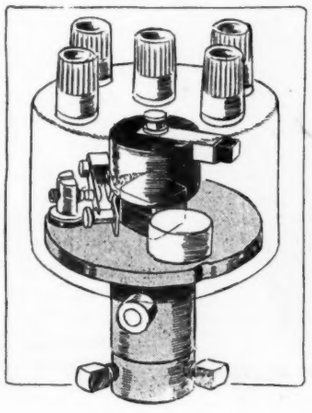
Halladay Is Ford System

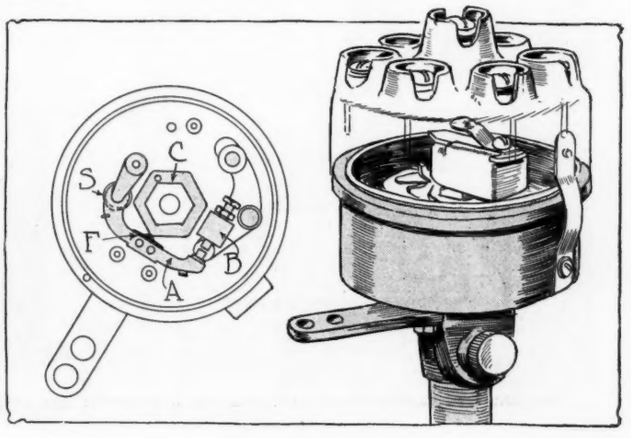
The L. P. Halladay Co., Streator, Ill., has produced a unit coil ignition system for Ford cars consisting of a combined timer and distributer and the necessary fittings to attach it to a Ford motor. With this igniter the Ford switch is employed and one unit of the regular Ford coil equipment.

Since the coil and switch which are regularly placed on the Ford car are employed as part of the system, the principal feature of the Halladay part of the outfit is the timer distributer. This is a combined unit in which a rotating shaft carries a cam which acts upon a follower four times during a revolution of the distributer shaft. One contact point is carried on a flat spring, while the other is attached to a thick post on the end of an adjusting screw by means of which the wear on the points is taken up. The cam acts directly on a flat member attached to the part carrying the flat spring on which the contact point is mounted. The follower is held against the cam by means of a coil spring.

A bracket, which forms part of the system, is supplied with the outfit, and this takes the place of the regular Ford timer, which is discarded when the Halladay system is installed.







Above—Breaker mechanism and timer distributer of the Bosch Magneto Co. battery system

Right—The Halladay timer distributer

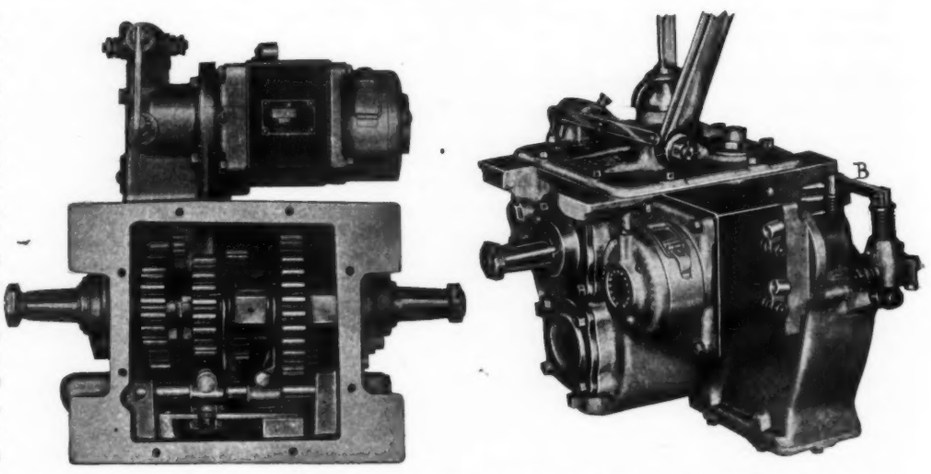
Extreme right—The breaker mechanism and the timer distributer of the Remy company

Brown-Lipe Gearset and Starter Unit

Clutch Can Be Used to Lighten Starting Effort

THERE are several points in favor of locating the starter elsewhere than on the motor, for the latter already has numerous accessories and fittings to carry. While the flywheel application often has many advantages, it is sometimes not convenient to arrange a place for the starting motor, so gearbox location, if equally efficient in operation, has distinct claims to notice. Illustrated herewith is a new product of the Brown-Lipe Gear Co., Syracuse, N. Y., which has been standardized for manufacture and can now be supplied rapidly.

On the floorboard is a push button that engages sliding gears in the box, marked A in the illustration, and this also throws over the switch B. As soon as the motor picks up, the starter is disengaged automatically both by switch and by gear sliding, so there are no extra parts in constant operation. The makers point out that various gear combinations can be provided to suit the needs of motors of various sizes; they also suggest that there are occasions when the starter may advantageously be employed to rotate the clutch while the latter is held out by the foot, clutch engagement being gradual as the motor gathers speed.



Brown-Lipe gearset with Westinghouse starter. A is starting gear and B shows switch control

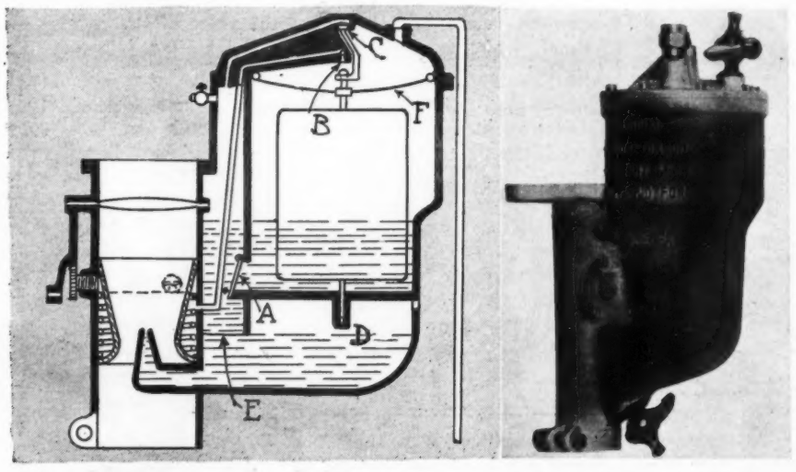
New Suction Feed System

THE idea of utilizing the depression in the intake to lift gasoline from a tank located below a possible gravity feed level finds expression in the vacuum carbureter system which is made by the Vacuum Carbureter Co., Detroit, Mich., either as a separate attachment for carbureters of standard pattern, or as a complete instrument with feed apparatus and carbureter integral.

There is a main chamber containing a float, the purpose of which is to control two small valves situated at the top of its stem. When the float is in the dropped or lower position, the lower valve is open and this uncovers a pipe leading to a point in the venturi near to the position of maximum depression. By these means the depression in the venturi is transferred to the float chamber and gasoline is drawn up from the main supply tank. Alongside the float chamber is a second smaller compartment with which the float chamber communicates by a non-return valve A. When the float rises it eventually closes the little valve B and opens the other little valve C, which of course, equalizes the air pressure in the float chamber and in the secondary compartment. As the air pressure is equalized the gasoline level will equalize likewise, the communicating valve A opening until the gasoline has settled in both chambers, whereupon the float falls and returns the top valves to their original setting, which leaves the second compartment a sealed chamber.

Now the jet is supplied from the bottom chamber D and when the level therein drops far enough a little air will bubble up into the smaller of the gasoline chambers through the orifice E. This air allows gasoline to descend, so lowering the fuel level in the small gasoline chamber until such time as the float is again high enough to throw over the top valves and recharge both chambers. By these means there is maintained an ever constant level in the bottom chamber D. In the whole system there are only the three valves A, B, and C.

A flat spring F is mounted above the float in such a state of tension that it tends to hold the float either up or down; when in the lifted position the spring prevents the float from falling till there has been a fair drop in the fuel level, and it likewise holds down the float until a considerable rise has occurred. This guards against fluttering or unsteady action.



Suction feed carbureter attachment and diagram of the method of operation

Original Knight Racing Motor

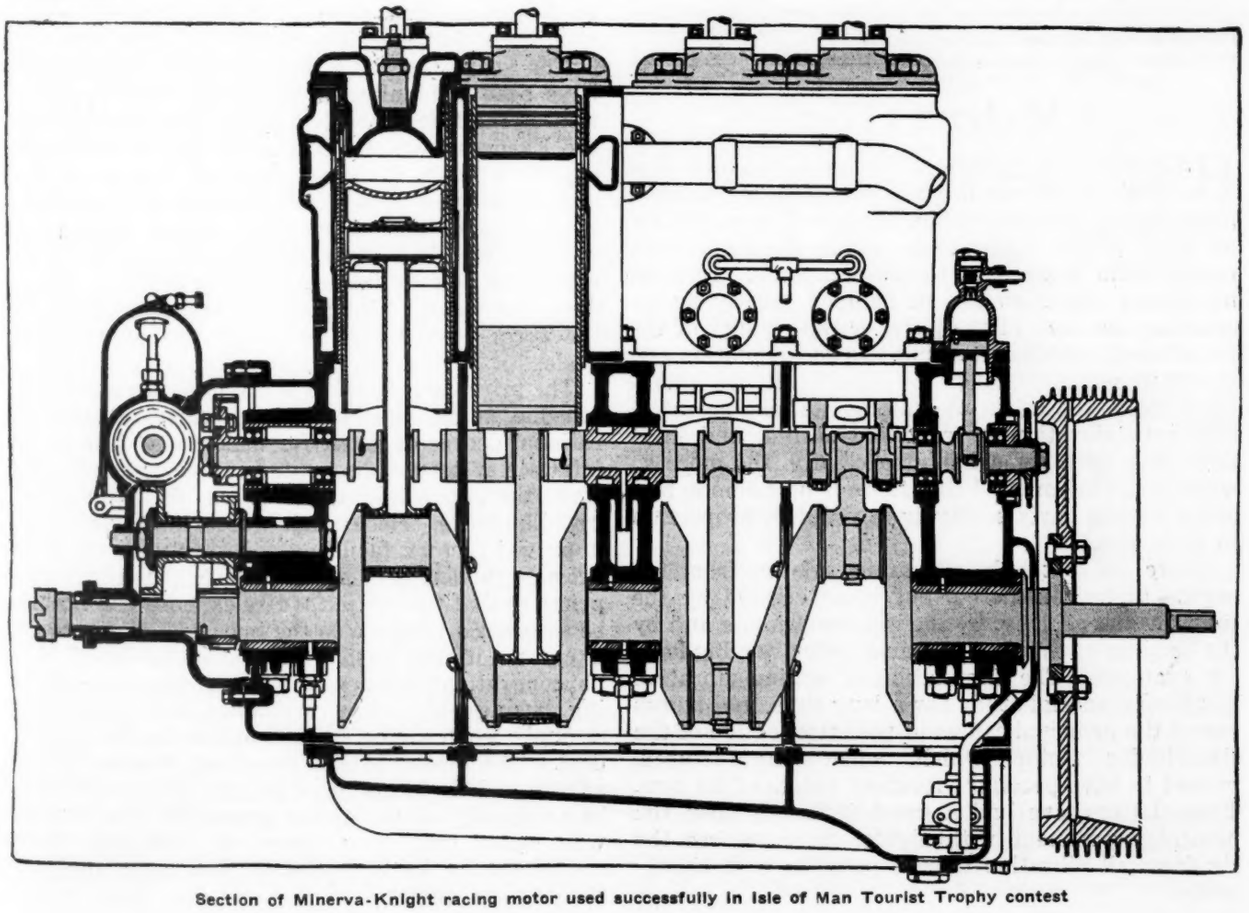
Special Features May Be Used Again in American Development of Design

IT was in the Tourist Trophy race in the Isle of Man last June that the Knight motor made its first entrance to the racing field in England, and, though the Minerva Co. had practically no experience of racing, the success of the car was really remarkable. It was understood at the time that some of the special features of the design had proved good and some less satisfactory, so it will be interesting to compare the Knight motor to be used for American racing with the Minerva in order to see what details have been perpetuated. The Minerva engine's dimensions were 3.54 inches bore and 5.1 inch stroke, the most striking difference in construction being that the sleeves were operated by two shafts instead of one—like a T-head poppet valve motor. The sleeves were lifted from one side only and the use of two shafts was to permit double sized bearings for the little sleeve connecting-rods. At the foot of each cylinder there was a supplementary exhaust port opened and closed by the sleeves and this was responsible for a great loss of oil and heavy smoking. Chas. Y. Knight was reported as having declared his intention of trying, in any future racing motors, the experiment of using the bottom ports as intakes instead of exhaust outlets, but be this as it may, the additional port area has a great effect on the power.

There was a double lubricating system, an ordinary gear pump supplying the drilled crankshaft, while a special plunger pump supplied the sleeves. This pump sent oil under pressure to a cavity in the cylinder wall and also sucked it back from the same place, the idea being to insure a supply to the sleeves and to prevent the accumulation of such pressure that oil could be pumped actually into the combustion space. The outer sleeve was drilled with many large holes, partly to decrease its weight and partly to allow oil to pass to the inner working surface.

In this design the usual silent chain was replaced by spur gearing, since the latter suited better for driving two sleeve shafts and noise was of no importance.

The difficulty with the Knight motor for racing is to get sufficient port opening in conjunction with sufficient overlap of the sleeves effectually to close the ports during the working stroke, but the sleeves allow supplementary ports to be used without their drawbacks as found on an ordinary motor, because they can be opened and closed as desired instead of being open continuously. Thus it is almost certain that some sort of additional porting will be employed on the new designs even though it may be quite different from that of the Minerva motor.



Section of Minerva-Knight racing motor used successfully in Isle of Man Tourist Trophy contest

The Automobile

PUBLISHED WEEKLY
Copyright 1915 by The Class Journal Co.
Vol. XXXII Thursday, February 11, 1915 No. 6

THE CLASS JOURNAL COMPANY
Horace M. Swetland, President
W. I. Ralph, Vice-President E. M. Corey, Treasurer
A. B. Swetland, Secretary
T. B. Van Alstyne, Advertising Manager
231-241 West 39th Street, New York City

EDITORIAL
David Beecroft, Directing Editor
Donald McLeod Lay A. Ludlow Clayden
J. Edward Schipper Sydney Oxberry
L. V. Spencer, Special Representative, Detroit

BRANCH OFFICES
Chicago—910 South Michigan Avenue, Phone Harrison 7707
Detroit—95 Fort St., West
Boston—1035 Old South Bldg., Phone Fort Hill 3292
Cleveland—516-517 Swetland Bldg., Phone Prospect 167

Cable Address ---------- Autoland, New York
Long Distance Telephone ---------- 2046 Bryant, New York

SUBSCRIPTION RATES
United States and Mexico ---------- One Year, $3.00
Other Countries in Postal Union, including Canada ---------- One Year, 5.00
To Subscribers—Do not send money by ordinary mail. Remit by Draft, Post-Office or Express Money Order, or Register your letter.

Entered at New York, N. Y., as second-class matter.
Member of the Audit Bureau of Circulations.
The Automobile is a consolidation of The Automobile (monthly) and the Motor Review (weekly), May, 1902, Dealer and Repairman (monthly), October, 1903, and the Automobile Magazine (monthly), July, 1907.

Vibration

HARDLY is it possible to design a machine that will not vibrate in some part or other, and the make up of the automobile renders it particularly prone to produce vibrations within the range that makes them unpleasant to the occupants. In most machinery vibration can be damped greatly by increasing the mass of the parts or the rigidity of the foundation, but an automobile has no foundation and it is impossible to add to its weight. It has, therefore, been the task of automobile engineers to eliminate vibration by scientific design, and in it they have been remarkably successful, the more so when it is remembered that there is no common machine having parts so highly stressed in proportion to their size.

There are not only vibrations arising from the engine to be considered, but those created by the road, by the gearing, by the universal joints and by the bending of the chassis frame under varying load, for example. The elimination of engine vibration has been a special study for a long time, and it was one of the principal causes of the introduction of the six-cylinder motor, which, when manufactured, proved to have peculiar vibratory habits of its own. These latter have had a great influence upon the present experiment with eights, since to free the six from all vibration though possible, is distinctly costly.

Meanwhile road vibration is obtaining almost as much attention, for there is a fresh wave of enthusiasm for the improvement of springs, and gearing shows the attention given to it by the growth of the worm and the spiral bevel—for though these have their reason in the desire to reduce noise, what is noise but another word for vibration? Yet in all these things, motors, springs or gears, we are a long way yet from finality in design, and perhaps further yet in the matter of choosing material and handling it when chosen. It is a curious fact that the approach to a standard type of machine always serves to show up its faults—it was the general use of six cylinders which proved that the original makers of small quantities had not been getting the best results possible: so it might be said as a general rule that we only begin properly to understand a feature of automobile design a year or two after it has become standard practice. At present vibration pure and simple, or the noise that arises from vibration are the most noteworthy faults in automobiles and nearly all recent changes have been aimed at their reduction.

Tire Prices

ALTHOUGH the progress of the various branches of the automobile and accessory industries has been steady and apparently inevitable since their inception, the revision of tire prices is one of the most encouraging signs of rapid improvement in conditions that has been visible for some time.

For years the list prices of our tire companies have been gradually coming down, with the exception of the brief period of panic last summer when the European war threatened to cut off our rubber supply, but also for years the man who knew could always buy new tires at prices far below those listed by the maker and which were meekly paid by the uninitiated. The experienced car owner or driver who knew how to link together the chain of possible discounts secured his tires at a reasonable rate while the tyro was at the mercy of the unscrupulous dealer.

The prices now in effect are apparently much more sensible, being based on manufacturing costs and a rational degree of profit for maker and dealer. The intricate system of discounts is abolished and henceforth the man who buys tires will do so on a business-like basis. Better manufacturing methods and improved factory facilities, together with the lower price of rubber, have made possible the reduction of prices so that the matter of tire expense will not now be so great a bugaboo to the man who wants to buy a car as in the past. Everyone concerned is to be congratulated upon the good sense of adopting business-like sales principles and, even more strongly, upon giving the automobile public a square deal. The dealer is also benefited because he can adhere strictly to his price list and does not have to be constantly combating the arguments of customers who claim that they know of instances where acquaintances have purchased the same make of tire for less money.

138,250 Carloads in 1914 Car Shipments

14 Per Cent. Gain Over 1913—Each Freight Car Carried Two to Six Automobiles—N. A. C. C. to Fight Increases in Railroad Charges

NEW YORK CITY, Feb. 8—At the last meeting of the directors of the National Automobile Chamber of Commerce it was reported that the shipment of automobiles from factories of this country in the year 1914 reached the tremendous volume of 138,250 carloads, each car usually containing from two to six complete automobiles and in some cases more when the machines were taken apart to a greater extent than is ordinarily the case. This is about 14 per cent. greater than the cars required for the shipping of automobiles in the year 1913 and is easily one of the most important items of traffic in high grade manufactured articles handled by the railroads, whose earnings on these shipments are now estimated at upwards of $15,000,000 per year.

The traffic committee also reported that the traffic department had conducted a meeting of the association's representatives at Detroit, January 20, at which all details of freight classification relating to the various kinds of self-propelling vehicles were carefully gone over and that this matter was further considered at a meeting with the uniform classification committee of the railroads at Chicago, January 25.

The department is taking a keen interest in further proceedings before the Interstate Commerce Commission on the proposed extra charge by railroads for placing cars on factory sidings. This service has always been considered as included in the freight rate on automobiles as well as on all other kinds of freight, and it is expected that the N. A. C. C. and all other shipping interests will resist to the utmost any effort to charge more for placing cars on terminals provided on private property than if the manufacturers made use of the railroads' own terminals, which are purchased and maintained at great expense to the carriers and would certainly have to be enlarged many times if all shippers used them.

Another matter that the traffic department is strongly resisting is a suggestion by some of the southern railroads that automobiles be acceped for shipment only when tops are removed or that a higher rating be charged; also a requirement that automobiles must in all cases be covered when shipped and that detachable parts must be removed and packed in iron-bound boxes.

New York January Registrations $564,010

ALBANY, N. Y., Feb. 6—Motorists contributed more than $500,000 during January, 1915, or nearly $200,000 over the amount paid in the same period last year, despite a loss of approximately $40,000 due to a half fee provision for cars registered for 4 years previous, according to a statement issued yesterday by Secretary of State Francis M. Hugo. Secretary Hugo's figures also show that more business was handled by the automobile bureaus during the first month of this year than during all of January and February in 1914, or the first 3 months in 1913.

Last month a total of $564,010.50 was collected from 65,455 owners and 32,733 chauffeurs. The New York office registered 40,103 owners, 29,079 chauffeurs, taking in $371,473.50, while during the same period last year 26,392 owners, 27,767 chauffeurs and $290,483 were attended to. The Buffalo branch handled 14,170 owners, 3,500 chauffeurs, collecting $110,450 against 5,418 owners, 1,299 chauffeurs and $48,590 contributed in 1914. The Albany bureau registered 11,182 owners, 3,494 chauffeurs, from whom $88,899 was collected, although last year only 5,418 owners, 2,760 chauffeurs and $56,025 were accounted for. The deficit due to half fees amounted to $39,140, of which sum $26,287.50 arose in New York, $6,752.50 in Buffalo and $6,100 in Albany.

TRENTON, N. J., Feb. 5—Automobile licenses in New Jersey for January, 1915, amounted to $259,835, an increase of 40 per cent. over December, 1914. The yearly income to the State is $1,140,000. Registrations of 26,839 motor vehicles were made during the past month, against 18,645 in January, 1914.

OLYMPIA, WASH., Feb. 2—There were 741 motor vehicle licenses issued during the month of January to automobile owners in the State of Washington, as compared with 319 during January, 1914, an increase of 132 per cent.

NEW YORK CITY, Feb. 8—Frank H. Bowen has been appointed manager of the sales department New York branch of the Locomobile Co. of America. Mr. Bowen has been with S. G. V. and Simplex during the past 6 years. John F. Plummer, New York manager of the company states that the territory of this branch has been extended to include the entire state, both wholesale and retail, and agencies will be established in some of the larger cities.

1,279 Trucks Exported in December

WASHINGTON, D. C., Feb. 9—*Special Telegram*—Demand for trucks for European war purposes is indicated in export figures issued today by the Bureau of Statistics. In December last 1,279 commercial vehicles, valued at $3,387,729 were exported, together with 1,297 passenger cars, valued at $998,698. In December, 1913, eighty-eight commercial cars valued at $100,660 and 2,301 passenger cars, worth $2,052,484 were exported.

During the calendar year number of commercial cars exported increased from 1,009 worth $1,686,807, in 1913, to 3,430, value $8,985,756 in 1914, while the number of passenger cars decreased from 25,880, worth $25,343,644 to 22,335, value $19,521,708 during the same period.

3,500 Franklins for 1915

SYRACUSE, N. Y., Feb. 6—It is announced that plans have been made by the Franklin Automobile Co., to increase its production to 3,500 cars a year. It is stated that this is a 40 per cent. increase over last year. This shows a steady increase for this company for the past years as the 1914 production was stated to be 30 per cent. greater than that of 1913.

At the annual meeting held last week, the company elected directors and officers. The H. H. Franklin Mfg. Co., president, H. H. Franklin; vice-president, John Wilkinson; secretary and treasurer, F. A. Barton. The directors are the officers and E. H. Dann, G. H. Stilwell, A. T. Brown, W. C. Lipe and Arthur Holmes. For the Franklin Automobile Co. the officers are: President, H. H. Franklin; vice-president, Arthur Holmes; secretary and treasurer, F. A. Barton. The directors are the officers and E. H. Dann and John Wilkinson.

Heising Is Moon Chief Engineer

ST. LOUIS, MO., Feb. 8—G. F. Heising has succeeded L. F. Goodspeed as chief engineer of the Moon Motor Car Co., this city, Mr. Goodspeed having resigned on February 1. Mr. Heising still retains his grasp upon the purchasing department, and is assisted by C. W. Burst, who was formerly assistant superintendent.

WEEDSPORT, N. Y., Feb. 8—The Whitwood Corp., manufacturer of commercial vehicles, this city, will disorganize that corporation and will discontinue the business. The company terminates its existence without financial embarrassment.

Republic Truck Declares 100 Per Cent. Dividend

DETROIT, MICH., Feb. 9—*Special Telegram*—A dividend of 100 per cent. was declared payable today at the annual meeting of the stockholders of the Republic Motor Truck Co., Alma, Mich.

$1,000,000 for Lozier—New Co. Promised

Creditors May Receive 30 Per Cent.—Plattsburg Plant May Remain Closed or Be Sold

DETROIT, MICH., Feb. 6—An even million dollars was bid and accepted yesterday for the total assets of the bankrupt Lozier Motor Co. The purchasers are the Frank Brothers Iron & Metal Co.; the Harris Bros., Co.,—both of Detroit; Theodore Friedberg, and Charles Shongood, both of New York. The first three parties are in the metal and machinery business and Shongood is a United States auctioneer, in New York.

Speaking about the future plans of the purchasers, Samuel Frank stated that the Lozier Motor Co., will be operated as a going concern within the next 10 days and a new company will be organized with sufficient capital to permit the immediate re-opening of the plant. There is a possibility that the Plattsburg property will remain closed for the time being or disposed of to other parties.

The total assets of the Lozier company had been appraised by that concern at $4,899,972.65, but the appraisers of the Detroit Trust Co., trustee, figured the liquidation value of the quick assets at $1,366,584.46 and the land and buildings at $866,873.23, as a going concern, or the total assets at $2,233,457.69.

It is estimated that after all the expenses are paid, such as court fees, attorney's bills, etc., there will be sufficient funds to eventually pay about 30 per cent. of their claims to the creditors.

Rolls-Royce Profits Decrease $71,500

LONDON, ENG., Feb. 3—Profits of the Rolls-Royce, Ltd., decreased $71,500 in 1914, compared with the previous year. A dividend of 10 per cent. was recommended instead of the 20 per cent. in 1913. The loss in earnings and lower dividend rate were due entirely to the war. Net profits in 1914 were $384,255 against $455,920 in 1913. The dividend of 10 per cent. was earned three and one-half times over.

The company has been exceptionally prosperous in past years, and in the last 8 years and 8 months has paid out in dividends a sum equal to the entire capital subscribed by the original shareholders.

The situation caused by the war was saved to a large extent by the acceptance of orders for ordnance, which while yielding little profit, kept the factories running and the men employed. The production of motor chassis has already recovered to half the maximum before attained.

Kelly-Springfield Profits Gain $939,194

NEW YORK CITY, Feb. 9—The Kelly-Springfield Tire Co., which closed its fiscal year December 31, 1914, reports a net increase in income of more than 100 per cent. The gross profit for the year increased $939,194, the net income being $1,215,143. During 1913, the income was but $559,543. Liberal reserves have been made for bad and doubtful accounts receivable and the inventories of merchandise and materials which increased $563,757 during the year have been priced at cost with crude rubber at less than the market prices prevailing at the end of the year. Out of the earnings a sinking fund of 2 per cent. has been set aside for dividends on the 6 per cent. preferred stock.

	1914	1913
Gross profit	$2,203,761.00	$1,264,567
Operating and administrative expense	1,014,015.73	716,189
Net operating income	1,189,745.67	548,378
Other income	41,874.36	43,376
Total income	$1,215,143.71	$559,543

The balance sheet of the company, as of December 31, 1914, shows assets as follows: Cash, $380,414.81; notes and accounts receivable of respectively $114,302.31 and $533,832.78, less reserve for bad debts and discounts of $134,846.02, total $513,289.07; inventories at cost, $1,795,365.33, less the deferred charges to operations of $28,335.72 makes the current assets, $2,717,404.93.

Liabilities are as follows: Accounts payable, $61,099.32; accrued charges, $49,428.13; dividends and interest payable, $143,049, making the current liabilities, $253,576.45; 50-year sinking fund 4 per cent. income debenture bonds, $270,000; capital stock, $8,665,400; sinking fund for redemption of stock and bonds, $201,537.94.

Gray & Davis 1914 Sales $4,000,000

BOSTON, MASS., Feb. 6—The gross sales of Gray & Davis for 1914, are understood to be $4,000,000, a new high mark. The first 6 months registered sales of $2,500,000, the final half year tapering off normally to around $1,500,000. The earnings for the full year were in excess of $300,000, over two-thirds of which was contributed in the 6 months to June 30. At this rate, earnings upon the preferred stock are equivalent to about six times the dividend requirements, the outstanding preferred having increased from $500,000 to $750,000 during the year.

Studebaker Earnings Amount to $4,000,000

SOUTH BEND, IND., Feb. 6—The Studebaker Corp., this city and Detroit, is reported to have earned $4,000,000 in 1914. The exact figures are not available as yet, as the financial report is still in the hands of the accountants. After taking out the $900,000 for the preferred stock dividend, $3,100,000 is left for the common, or approximately 11 per cent. on the $27,931,600 outstanding. This compares with $1,003,338 or 3.59 per cent. for the common in 1913.

SOUTH BEND, IND., Feb. 3—A dividend of 1 3-4 per cent. was declared by the Studebaker Corp. to its stockholders. The annual session of the directors was held at the South Bend offices yesterday, the declaring of the dividend being the feature of the meeting. The dividend declared is payable on March 1 to all stockholders of record on February 20.

Automobile Securities Quotations

NEW YORK CITY, Feb. 8—Although the general tone of the market was somewhat unsteady during the past week the prevailing tendency of prices may be characterized as upward. Kelly-Springfield Tire continued strong, the common going up 10 points and the second preferred 5. Willys-Overland common gained 6 1-2 and the preferred 2, while Maxwell common gained 3-4, first preferred 4 1-4 and second preferred 2. Studebaker common gained 4 5-8 and preferred 2 1-2. Tire companies also showed slight gains. At the end of the week nearly all the stocks either were quoted at the same figure as last week or somewhat higher, there being only five instances of lower prices.

	1914 Bid	1914 Asked	1915 Bid	1915 Asked	Net Ch'ges
Ajax-Grieb Rubber Co. com	200	..	250	..	..
Ajax-Grieb Rubber Co. pfd	98	101	100	..	..
Aluminum Castings pfd	97	100	95	100	..
J. I. Case pfd	..	..	..	85	..
Chalmers Motor Co. com	..	90	..	94	..
Chalmers Motor Co. pfd	92¾	93½	91	94	+1
Electric Storage Battery Co	..	..	47½	48½	..
Firestone Tire & Rubber Co. com	246	252	370	375	..
Firestone Tire & Rubber Co. pfd	105	107	109	111	..
General Motors Co. com	55	56½	93½	94½	+ ½
General Motors Co. pfd	89	90	94½	95½	— ½
B. F. Goodrich Co. com	25	25½	32⅝	33	+1⅞
B. F. Goodrich Co. pfd	90	92	96⅜	97	+ ⅜
Goodyear Tire & Rubber Co. com	215	225	190	194	—3
Goodyear Tire & Rubber Co. pfd	98	100	101	102	— ¾
Gray & Davis, Inc., pfd	90	97	..	..	..
International Motor Co. com	..	5	..	..	..
International Motor Co. pfd	..	15	..	..	..
Kelly-Springfield Tire Co. com	..	..	107	107½	+10
Kelly-Springfield Tire Co. 1st pfd	..	..	82	83	..
Kelly-Springfield Tire Co. 2d pfd	..	..	117	120	+5
Maxwell Motor Co. com	5	5½	17¾	18¼	+ ¾
Maxwell Motor Co. 1st pfd	28	29	58¼	59¼	+4¼
Maxwell Motor Co. 2d pfd	9½	10	22¼	22½	+2
Miller Rubber Co. com	..	..	158	165	..
Miller Rubber Co. pfd	..	..	101	103	..
New Departure Mfg. Co. com	..	..	117	122	..
New Departure Mfg. Co. pfd	..	..	105	107	..
Packard Motor Car Co. com	..	..	..	100	..
Packard Motor Car Co. pfd	95	98½	93	..	..
Peerless Motor Car Co. com	15	25	13	20	..
Peerless Motor Car Co. pfd	75	80	..	55	..
Portage Rubber Co. com	..	40	30	36	..
Portage Rubber Co. pfd	..	90	80	85	..
*Reo Motor Truck Co	7	7½	11⅝	12¼	+ ⅛
*Reo Motor Car Co	17½	18½	24½	25	..
Splitdorf Electric Co. pfd	..	..	..	..	..
Stewart-Warner Speed. Corp. com	54	56	49½	50¼	+1½
Stewart-Warner Speed. Corp. pfd	98	..	100½	103	— ½
Studebaker Corporation com	29	30	46⅛	46½	+4⅜
Studebaker Corporation pfd	86½	87	94½	96½	+2½
Swinehart Tire & Rubber Co	69	71	69	71	..
Texas Company	..	..	131	135	..
U. S. Rubber Co. com	59	59½	56¼	57	+ ¼
U. S. Rubber Co. pfd	101¾	102	102¾	103⅛	+ ¾
Vacuum Oil Co	..	..	193	196	—2
White Co. pfd	105	110	108	110	..
Willys-Overland Co. com	65	67	96½	98½	+6½
Willys-Overland Co. pfd	91	95	95	97	+2

*Par value $10; all others $100 par value.

To Reorganize Krit Company

Winternitz Buys Assets of Car and Sales Concerns for $120,000 —Will Build New Cars

DETROIT, MICH., Feb. 6—The combined assets of the Krit Motor Car Co., and the Krit Sales Co., which had been appraised by these companies at a total of $879,347.97 and by the official appraisers at $210,436 were purchased yesterday for $120,000 by Samuel Winternitz & Co., Chicago, the sale being confirmed by the referee in bankruptcy.

In commenting upon the purchase, the Winternitz company said that it is its intention to re-organize the Krit concern. An announcement will be made as soon as the plans have been perfected. "We are going to complete all the unfinished cars and with the material on hand build new ones, and hope to have the re-organized company in running order very shortly," said one of the officials of the Chicago company.

The Chicago concern made a deposit of $12,000 and also gave a bond of $25,000 to guarantee that it will keep its engagement, the bond being given to Frank W. Blair, of the Union Trust Co., trustee for the Krit Motor Car Co., and to Henry Lansdale, trustee for the Krit Sales Co. It was also agreed that if the total amount of $120,000 is paid within 90 days a discount of 2 1-2 per cent., or $3,000, will be allowed.

For its purchasing price the Winternitz company obtained stock of material, finished and unfinished cars and chassis, having a total value of $161,546.03; factory equipment, tools, jigs, office furniture, etc., valued at $21,453.71; patterns, dies, drawings valued at $2,500; ten cars and trucks used by the Krit plant and valued at $3,375; equity in buildings, land and in land contract covering the premises on which the Krit Motor Car Co. is located, valued at $15,000; stocks of parts, tools, supplies, office furniture and fixtures, located in the Philadelphia branch, valued at $6,561.28.

—

Michigan's 1914 Exports $7,890,230

DETROIT, MICH., Feb. 4—The total value of the automobiles, parts and accessories exported in 1914 by the manufacturers located in the state of Michigan was $7,890,230. From this total $6,108,677, or 77 per cent., is credited to Detroit manufacturing concerns.

The exports from Michigan consisted of 4,961 passenger cars of a total value of $4,693,792, or an average of $946 per car; 273 trucks and delivery vehicles valued at $404,873, or an average of $1,483 each; automobile parts and accessories valued at $2,695,788 and $95,777 worth of tires, which are now recorded separately.

Detroit naturally was the center of the export business and of the total of 4,961 passenger cars exported last year 3,923 or 80 per cent. were shipped from this city, also 174 out of the total of 273 trucks, or 63 per cent. Compared with 1913 there was a decrease of 200 in the number of passenger cars exported and fifty in the number of trucks. For some countries the exports were heavier than in 1913, for others there was a great decrease. For instance only ninety-six passenger cars were shipped to South Africa last year as compared with 719 in 1913. The number shipped to England in 1914 was 1,946, or 338 more than in 1913.

—

Cleveland Plants Busy On War Orders

CLEVELAND, O., Feb. 5—Authentic information in Cleveland financial circles discloses an order received by the White Co., from the Russian government for 500 2-ton and 500 3-ton trucks, at an estimated cost of something over $2,000,000. White company officials, however, have maintained secrecy regarding their foreign business.

The Peerless plant has been busy several weeks on a continuous order from the British government for an unstated number of trucks. Shares of the Peerless Motor Car Co. have developed a much stronger demand in the Cleveland market and it was inferred that the company had increased its weekly output for early shipment. Stock of the company has risen from a weak market around $15 a share to a strong market at above $20 a share.

The activity of the allied governments in placing orders for war munitions and supplies is coincident with the completion of arrangements by J. P. Morgan & Co., of New York to act as representatives of the British government in this country. The Wall street financial firm has named Edward R. Stettinius, president of the Diamond Match Co., as its commercial agent to handle foreign business.

—

TROY, O., Feb. 3—A cable order has been received from a foreign government by the Troy Wagon Works Co., this city, for 350 motor truck trailers at $1,256 each.

—

Ordnance Officer to Buy Trucks

WASHINGTON, D. C., Feb. 6—The war department today issued orders to Capt. J. B. Rose, ordnance department, to proceed to the works of the Packard Motor Car Co., Detroit, Mich., "on official business pertaining to the procurement of armored automobiles for the ordnance department." The issuance of this order indicates the United States army has decided to procure new armored cars of the types that have been so efficient in the European conflict.

—

Government Wants Truck Estimates

WASHINGTON, D. C., Feb. 6—The secretary of the treasury has issued a call for sealed proposals for furnishing the various executive departments in this city with gasoline and electric trucks during the fiscal year beginning July 1, next. The bids will be opened at 2 o'clock, March 10, by the general supply committee. The number of trucks required is not given. Strict specifications have been issued to which bidders must closely adhere.

Detailed information, together with proposal blanks, can be obtained upon aplication to the General Supply Committee, Auditor's Bldg., this city.

—

NEW YORK CITY, Feb. 6—The American-La France Fire Engine Co., Inc., reports for the year ended December 31 last net profits $350,645 and a surplus after 7 per cent. dividends on the preferred stock of $210,645. The profit and loss balance on December 31 last was $310,208. As compared with the previous year, the net earnings show a gain of $112,491. As a result of favorable earnings for 1914, the directors have declared a dividend of 1 per cent. on the common stock, payable February 15 to stock of record February 1. The company has $2,000,000 7 per cent. preferred stock, and $1,450,000 common stock, with $51,325 first mortgage bonds.

Market Reports for the Week

NEW YORK CITY, Feb. 9—This week's market reports were fairly steady with the exception of a few fluctuations in the cottonseed oil, tin and tire scrap prices. Cottonseed oil rose to $7.15 and then closed at $7.00 at a drop of $0.12 per barrel; tin went below and then above its opening price and then closed with no change, its price being $37.00 per 100 pounds. Tire scrap dropped to $0.04 1-2 on Friday but immediately rose to $0.05, maintaining that price to the close on Monday. Though fine Up-River Para rubber went up $0.08 1-2, it was fairly steady after Thursday. Trading in crude rubber was restricted to small lots as a rule. The offerings of Para rubber were reported as light and the market was firmer. Supplies are reported to be light. There was a small demand for electrolytic copper at the latter part of the week from domestic consumers for March, April and May shipments. Copper exports in 1914 amounted to 360,299 tons while the imports amounted to 134,000 tons.

Material	Wed.	Thurs.	Fri.	Sat.	Mon.	Week's Changes
Antimony	.17	.17	.17	.17	.17	.....
Beams & Channels, 100 lbs.	1.21	1.21	1.21	1.21	1.21	.....
Bessemer Steel, ton	18.50	18.50	18.50	18.50	18.50	.....
Copper, Elec., lb	.14⅝	.14½	.14½	.14½	.14⅜	—.00¼
Copper, Lake, lb	.14¾	.14⅝	.14⅝	.14⅝	.14⅝	—.00⅛
Cottonseed Oil, bbl	7.12	7.15	7.13	7.10	7.00	—.12
Cyanide Potash, lb	.21	.21	.21	.21	.21	.....
Fish Oil, Menhaden, Brown	.41	.41	.41	.41	.41	.....
Gasoline, Auto, bbl	.12	.12	.12	.12	.12	.....
Lard Oil, prime	.90	.90	.90	.90	.90	.....
Lead, 100 lbs	3.80	3.80	3.80	3.80	3.80	.....
Linseed Oil	.60	.60	.60	.60	.60	.....
Open-Hearth Steel, ton	18.50	18.50	18.50	18.50	18.50	.....
Petroleum, bbl., Kans., crude	.55	.55	.55	.55	.55	.....
Petroleum, bbl., Pa., crude	1.50	1.50	1.50	1.50	1.50	.....
Rapeseed Oil, refined	.71	.71	.71	.71	.75	+.04
Rubber, Fine Up-River, Para	.50	.57½	.57½	.57½	.58½	+.08½
Silk, raw, Ital	..	3.90	..	..	3.90	.....
Silk, raw, Japan	..	3.42½	..	..	3.40	—.02½
Sulphuric Acid, 60 Baume	.90	.90	.90	.90	.90	.....
Tin, 100 lbs	37.00	36.50	37.13	37.00	37.00	.....
Tire Scrap	.05	.05	.04½	.05	.05	.....

Decision Rendered in Carbureter Suit

Zenith Wins on Present Model But Loses to Stromberg on Two Discontinued Types

CHICAGO, ILL., Feb. 3—Judge Sanborn, in the United States district court for the northern district of Illinois, decided today the suit of the Stromberg Motor Devices Co., Chicago, against the Zenith Carbureter Co., Detroit, Mich., in favor of the Zenith company, in regard to one model now being manufactured and against the Detroit concern with reference to two discontinued models. The Ahara, Richard, Sturtevant and Anderson patents are those upon which the complainant based the present suit. The testimony was taken in September, 1914.

As the case stands the Stromberg company may collect on the two discontinued but infringing carbureters and appeal on errors in the case just decided. In all probability an appeal will be made by both concerns.

The case just decided in the lower court involved four carbureter patents as named above, two of which, the Ahara and Richard, were claimed to be infringed by previous Zenith types in the suit of the Stromberg company against the John A. Bender Co., Chicago agent for Keeton cars, which were equipped with Zenith devices.

The Bender case was decided in February, 1914, in favor of the Stromberg company. It will be remembered the Stromberg attorney attempted to convince the court that the Zenith company was a party in the suit for the reason it supplied fees and lawyers to conduct the defense. Bender declined to appeal, dropped the Zenith lawyers, engaged his own, dismissed the appeal and consented to final decree. This brought the Stromberg company face to face with the question of bringing suit against the Zenith company, the latter having issued a legal battle in May, 1914. The decision today was the result, but since the time of the Bender case the Zenith company has discontinued two types of carbureters which are said to infringe and is manufacturing and selling one type which is declared by Judge Sanborn to be free of infringement.

"If the Zenith does not infringe any of the complainant's patents in its main operation, as I think it does not, it should not be held to infringe on a minor operation, not clearly disclosed by any of such patents," says the Judge. "Infringement is, at least, doubtful and should not be decreed."

Judge Sanborn continued further, "As no infringement appears by the No. 2 carbureter no injunction should issue, but there should be a decree to the effect that the Ahara and Richard patents were infringed by the manufacture and sale of carbureters like Nos. 1 and 10 and for an accounting and damage without costs to either party."

The No. 2 carbureter is the one now being made and sold by Zenith. Nos. 1 and 10 are the discontinued types.

So it sums itself up into this. That the Stromberg company can collect royalty on the carrbureters called No. 1 and 10 which have been discontinued by the Zenith company but which were being made when the Bender suit was on. The three carbureters in question have manufacturing dates as follows: No. 1, made between August, 1911, and August, 1912; No. 10, made in March, 1912, and shortly afterwards discontinued, and No. 2 made between March, 1913, and April, 1914, and being made at the present time.

In the present case Judge Sanborn, in his decision, likens the suit to the previous one against Bender, saying: "In the Bender suit the decision turned on the distinction between suction-controlled and gravity-controlled noozzles and infringement was found because it was thought the Zenith device there shown like Ahara was not gravity-controlled in the secondary nozzle" . . . So the matter practically comes down to the question whether carbureters with two 3-16-inch vents said to create no vacuum at all in the U-tube, should be held to infringe."

Judge Sanborn evidently came to the conclusion cited above, because as he says, "The Bender decision went upon the theory that a 1-8-inch hole in the Zenith well would so restrict the U-tube as to create a vacuum therein and so operate just like the Ahara. The vents having now been enlarged so there is no sub-atmosphere (vacuum) in the well, the Ahara patent is not infringed."

The Richard patent, being an improvement of the Ahara, the judge similarly decreed that it was not infringed by the Zenith carbuheter now being made by the manufacturing company.

In commenting on the validity of the Sturtevant patent Judge Sanborn said, "Sturtevant is clearly valid but I do not think it infringed."

Relative to the Anderson patent the judge continued, "With all these differences (four were named in the decision) in means, operation and result, particularly in operation and construction, infringement is so doubtful that it should not be decreed."

The patents involved in this case are numbered as follows: Ahara 684,662, Richard, 791,501, Sturtevant re-issue, 12,611 and Anderson, 1,063,148.

The Ahara and Richard are somewhat the same, the latter being an improvement of the Ahara. This is known as the atmospheric well type, that is, a type of carbureter in which the proper mixture is maintained at the various engine speeds by means of an auxiliary supply of fuel from a well which communicates with the atmosphere and which is fed from the constant level fuel chamber or float chamber.

The Sturtevant patent relates to a combination of two distinct mixers, the main one for ordinary use and the other for low-speed and being in operation also when the other is working. The Anderson patent relates to the Stromberg model E, which has not been pushed extensively.

—

Body Makers Get $15,000 Judgment

DETROIT, MICH., Feb. 4—A default judgment for $15,000 was rendered by Judge Mandell in the Wayne County circuit court in favor of the Griswold Motor & Body Co., of this city, against George H. Partin, Chicago, and Henry E. Graper, of Tennessee, doing business as the Partin Mfg. Co., Lexington, Tenn.

The suit was filed April 28, 1914, on account of breach of contract, Partin and Graper having signed a contract November 21, 1913, with the Griswold company "for 1,000 touring car bodies as a minimum of 1,000 touring car bodies and a maximum of 2,000 to be taken during the season 1914, these bodies to be known as the Palmer Motor Car Six Passenger Body, and to be same as model now in possession of the K. C. Knapp Co." The price of these bodies was fixed at $48 each. December 20, 1913, Partin and Graper suggested several changes in the contract which was agreed upon by the Griswold company, the changes being in the construction of the bodies, which were to cost $50 each. It was further agreed to cancel 500 bodies and the other 500 were to be delivered half in March and half in April.

March 6 and April 6 the bodies were ready for delivery, but all efforts to reach either Partin or Graper or to communicate with them proved unsuccessful, it is claimed by the Griswold company. The bodies had to be stored and in order to cover themselves the body makers on April 13 had twenty-four cars and twelve chassis seized, all belonging to Partin and Graper, and valued at a total of $17,050.

—

Would Limit Truck Size: Fit Governors

NEW YORK CITY, Feb. 9—The Mayor's Central Committee on Street Traffic and Safety met yesterday at Police Headquarters to offer suggestions for making the city streets safer and for handling traffic more efficiently. Commissioner Woods said he was convinced that speeding motor trucks were one of the chief dangers, and offered the suggestion that these vehicles should be equipped with a governor to keep down their speed. The committee offered some fifty suggestions, one of the most drastic of which was that offered by Inspector Meyers in limiting the size of motor trucks and sight-seeing automobiles. He favored a law prohibiting such vehicles from exceeding 24 feet 6 inches in length, 7 feet 6 inches in width, and 12 feet 2 inches in height. He favored increasing the license tax on sight-seeing automobiles from $10 to $100 and wanted them kept off Fifth avenue and Broadway in the rush hours.

—

Two More Decisions for Prest-O-Lite

INDIANAPOLIS, IND., Feb. 8—That it is unlawful for anyone to refill a Prest-O-Lite tank, without first destroying its identity as a Prest-O-Lite tank by removing the name and trade-mark, has again been emphasized by the decision of the United States circuit court of appeals for the Eighth circuit in the case of The Prest-O-Lite Co. against Herman E. Heiden and Clark Howell, doing business as the Little Rock Headlight Co., Little Rock, Ark.

In passing upon this case last spring, the U. S. District Court for the eastern district of Arkansas held that it would be sufficient for the refiller to cover up the Prest-O-Lite trade-mark with a paper label. The decree of the U. S. District Court has been modified by the Circuit Court of Appeals so as to enjoin the defendants from "selling, exchanging or delivering such a tank so filled without completely and permanently obliterating and removing the trade-mark and other marks by letters or figures indicating that the tank is a Prest-O-Lite tank, and securely

fastening to it a conspicuous notice that the tank is not filled with Prest-O-Lite gas."

This decision in the Eighth circuit is in line with the decision of the Circuit Courts of Appeals for the Sixth and Seventh circuits on the same proposition, the effect of which is to remove from the refilled tanks all wording by which the Prest-O-Lite Co. could be deemed responsible for the service given by such tanks, or for their repair and exchange when empty.

CINCINNATI, O., Feb. 8—The United States Circuit Court at Cincinnati has handed down a decision providing for an injunction and denying the petition for a rehearing in the case of the Presto-O-Lite Co. against Arthur C. Davis and Victor Gluchowesky, as Coughlin & Davis and Davis et al. The injunction order as amended restrains the defendants, Coughlin & Davis, from directly or indirectly refilling tanks of the Prest-O-Lite Co., from reusing them in any way without first replating or enameling the outside surface in such a way as to completely obliterate the trade-marks of the Prest-O-Lite Co. or without permanently plating or stamping on the outer surface notice that the tank has been refilled or recharged by the defendants or their agents.

—

H. O. Smith Files Voluntary Petition

INDIANAPOLIS, IND., Feb. 6—Harold O. Smith, president of the Premier Motor Mfg. Co., now in the hands of a receiver, today filed a voluntary petition in bankruptcy in the United States court in this city. He states that his liabilities are $142,319.54 and his assets $122,584.06 and he claims the statutory exemption of $600.

Of his liabilities, $80,982.17 represents creditors holding Premier first and second series of preferred and common stock, owned by him, as security. His assets include the following Premier stock, the amount being the par value: 301.5 shares common $30,150; 127 shares first series preferred stock $12,700 and 785.8 shares second series preferred stock $78,580.

—

Receiver Appointed for Twombly Corp.

NEW YORK CITY, Feb. 9—F. W. Stelle has been appointed receiver for the Twombly Car Corp., with the power to continue business or to close up any of the establishments of the company. The appointment was made on application of D. Stuart Dodge, president and financial backer of the company, who alleges he advanced $114,439 to provide funds for pay-rolls and other expenses. He is the largest creditor. Outside of his claim, which amounts to $468,238, the liabilities will not exceed $10,000, to about seventy creditors. The tangible assets, it is asserted, do not exceed $35,000. aside from the patents and interests in contracts with W. I. Twombly, the inventor, which are of uncertain value.

Mr. Dodge in the petition, filed in the U. S. district court, stated that he was the financial backer of the companies, which included the Twombly Power Co., Twombly Motors Co., Twombly Taxicab Co., Inc., and the Twombly Car Corp., all of 1790 Broadway, this city. He also stated that he had no security for the above amount of money, which he loaned to the companies, beyond their promissory notes.

It is expected that a new company will be reorganized with new capital.

More Tire Makers Revise List Prices

—

General Tendency Is Downward— Other Manufacturers Considering Change to Meet New Lists

NEW YORK CITY, Feb. 8—The tire situation is clarifying itself and in the process tire lists quite generally are touching new low levels. Since the Goodrich company announced its new list and the abolishment of percentage discounts in favor of established list prices to the user and net prices to the dealer, half a dozen other makers have revised lists and in practically every case the new figures are lower than the old ones.

In the majority of cases, manufacturers have not as yet made definite decision with regard to revisions though it is admitted that these are being considered. Among those who are considering this are Swinehart, Thermoid, Empire, which reports that it probably will meet the general reduction, and Lee.

The reductions which have been announced are substantial in every case, as is revealed by the accompanying table, and they apply not only to plain treads but to non-skid treads and to tubes as well. Although the reductions which have been made apply in nearly every case to all sizes, in at least one case a reduction has been made only in casings 4 inches in diameter and over, no change being made in tube prices. This is the Kelly-Springfield company, which has reduced 4-inch casings 10 per cent. and 4 1-2 and over casings 12 1-2 per cent. At the same time, an important readjustment of mileage guarantee has been made, which is best explained in the company's own words:

"We are going to allow our dealers and distributers to increase the adjustment feature on our tires to 6,000 miles on plain tread and to 7,000 on our Kant Slip tire, in the Ford sizes. We will adjust on a basis of 5,000 miles for all plain tread tires 4 inches and above; and 6,000 miles on the Kant Slip type."

The companies which have as yet made no announcement include: Batavia, Federal, Miller, Falls, Republic and some others.

—

Strouse Small Car for $325

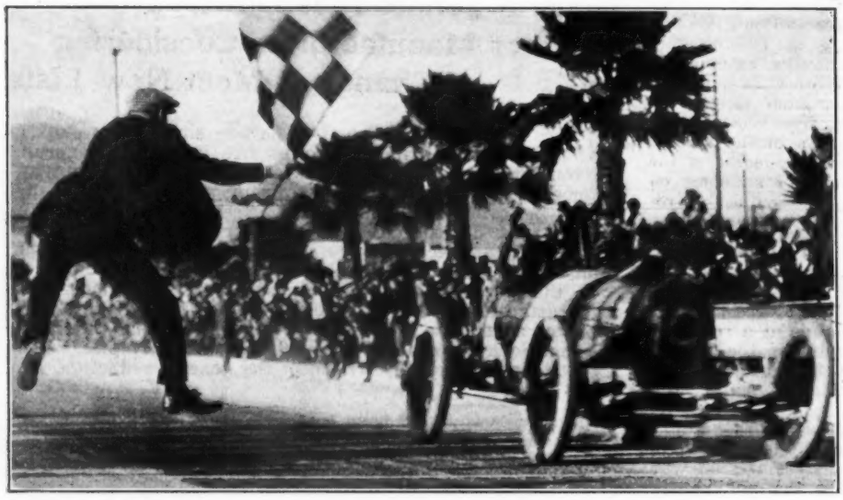
DETROIT, MICH., Feb. 3—The S. R. K. Motor Co. has been organized to make the Strouse small cars. The capital stock of the new company will be $100,000, none of which will be offered to the public. The incorporators are C. E. Strouse, designer of the car, who is a professor and M.A.; F. T. Ranney, a real estate dealer, and T. D. Knight, a wealthy retired Chicago lawyer. The Strouse car has a four-cylinder block Hermann motor, 2 1-2 by 4, 100-inch wheelbase, tread either 42 or 56 inches, 28 by 3 inches front and rear tires, gearless transmission, and will sell for $325 with the small tread and for $350 with the standard tread.

Old and New Tire Prices Quoted by Makers Who Have Revised Lists

Make		30 x 3		32 x 3½		34 x 4		36 x 4½	
		Old	New	Old	New	Old	New	Old	New
Braender	Plain	$11.70	$9.00	$16.75	$13.35	$24.35	$19.40	$35.00	$27.35
	Non-skid	14.05	10.35	22.10	15.35	29.20	22.30	42.00	31.45
	Tube	2.80	2.35	3.70	2.80	4.90	4.00	6.45	5.20
Firestone	Plain	12.30	9.40	17.60	13.75	26.20	19.90	36.75	28.70
	Non-skid	14.60	10.55	21.20	15.40	30.50	23.30	41.90	32.15
	Tube	2.80	2.20	3.70	2.70	4.90	3.90	6.45	5.00
Fisk	Plain	12.30	9.00	17.65	13.35	25.65	19.40	36.85	27.35
	Non-skid	13.30	9.45	19.05	14.00	27.40	20.35	39.05	28.70
	Tube	2.95	2.35	3.90	2.80	5.15	4.00	6.80	5.20
U. S.	Plain	11.70	9.00	16.75	13.35	24.35	19.40	35.00	27.35
	Chain Tread	14.05	10.70	20.10	16.00	29.20	23.95	42.00	32.85
	Tube	2.80	1.85	3.70	2.80	4.90	4.00	6.45	5.20
Goodyear	Plain	11.70	9.35	16.75	13.95	24.35	20.35	35.00	28.70
	Non-skid	13.70	10.95	19.60	16.30	28.50	23.80	40.95	33.60
	Tube	2.50	2.35	3.70	2.80	4.90	4.00	6.45	5.20
Kelly-Springfield	Plain	15.20	15.20	21.20	21.20	30.50	27.45	39.77	35.80
	Non-skid	18.10	18.10	25.30	25.30	36.90	33.55	46.57	41.40
	Tube	3.20	3.20	4.40	4.40	5.65	5.65	7.50	7.50
Ajax	Plain	12.65	9.60	....	....	26.30	20.65	37.85	29.10
Pennsylvania	Plain	10.80	9.40	....	....	22.90	20.35	32.15	28.70
	Vacuum Cup	14.40	13.00	....	....	34.00	28.95	46.35	38.55

Duesenbergs Win Glendale Road Race

O'Donnell Covers 103-Mile Course at 47.9 M. P. H. —Callaghan a Close Second— Oldfield's Mechanic, Hill, Third in Chevrolet— Ball, Marmon, Fourth



Barney Oldfield acrobatically gives checkered flag to Eddie O'Donnell in finish at Glendale

GLENDALE, CAL., Feb. 3—Eddie O'Donnell on a Duesenberg, won the Glendale road race, staged here today under the auspices of the Glendale Lodge No. 1289 B. P. O. E. O'Donnell's time for the 103-mile course was 2:07:07, or 47.9 miles per hour, which is a slow average, but when the nature of the course is taken into consideration, the speed of the winning Duesenberg is not to be discredited.

Jack Callaghan, also on a Duesenberg, won second place. His time was 2:10:25, or 47.5 miles an hour.

George Hill, Barney Oldfield's mechanic, driving a Chevrolet, captured third place, covering the 103 miles in 2:11:19.

There were twelve entries. At the wire, Tom Alley on Duesenberg No. 2, broke an axle and failed to get away. Huntley Gordon on the Gordon Special burned his brakes out in the first few miles of the race and after seventeen laps of nerve-racking driving he retired. Harry Reynolds, driving an Isotta-Fraschini, skidded on a turn and running into the curb, bent a front axle and retired in the twelfth lap.

A. A. Cadwell went out with a broken water system in the forty-eighth lap.

The Duesenbergs jumped into the lead on the first lap and held first and second places throughout the race. Gaston Morris, on a Renault held third place for twenty-seven laps then dropped to the rear when he over-ran a turn and blew a tire, losing nine minutes.

Cadwell held third place for ten laps, going back when trouble first developed in the water system. Hill went into third place on the fortieth lap and held that position to the finish. He drove a conservative race and never stopped during the contest.

Guy Ball on a Marmon won fourth money and William Taylor on the veteran Alco, which has figured in practically every California race during the past 2 years, won fifth money. Taylor's Alco has finished in the money in every race it has started in with the exception of the last Los Angeles to Phoenix road race. In the Desert Classic, the Alco was wrecked when it skidded into a telephone pole near the start. The old car came back and won a place in the San Diego race, having been in the repair shop at the time of the Corona Classic.

The length of the Glendale course is 1.9 miles, giving 53 laps to the race of 103 miles.

There were more than 16,000 spectators. Half the gate receipts went to the lodge for expenses and entertainment funds while the rest of the gate receipts went to the purse, which was cut into five prizes.

Harry Reynolds on his Isotta-Fraschini skids into death curve

Chicago Speedway Purse $50,000

CHICAGO, ILL., Feb. 9—The Chicago Speedway management has announced a $50,000 purse for the first ten placed in the 500-mile race which is to be run on June 19. In addition $1,000 will be given to the leaders at 100, 200, 300 and 400 miles, making the total of the purse $54,000. First prize is $20,000.

Exposition Entries Near 30 Mark

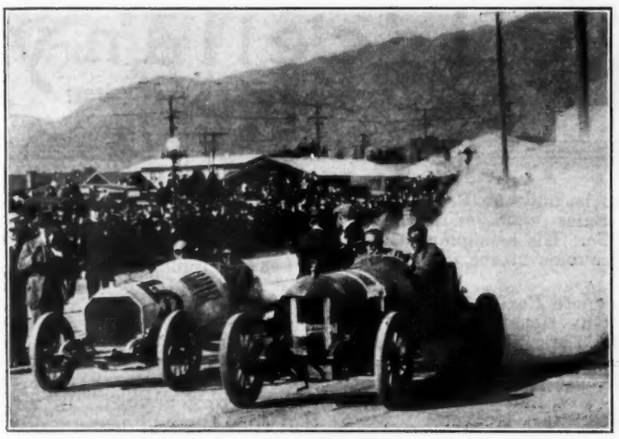
LOS ANGELES, CAL., Feb. 4—Huntly Gordon, owner of the fast Gordon Special which figured at Corona and at San Diego, announced here tonight that he had mailed his entry blank to Chairman W. L. Hughson, entering both the Vanderbilt Cup and Grand Prix races. This will bring the number of entries up to an even twenty-seven.

Arthur Klein stated today that he had entered his King car and would ship the machine to San Francisco at once. Klein's entry will take the place of one of the Peugeots, it is claimed, to complete the entry list. The second Peugeot entered is still in Los Angeles and Dario Resta and Fred J. McCarthy, both of the Peugeot team, said today that on account of the failure of parts to arrive from Europe, the Peugeot No. 9 will not start in the San Francisco races, but will remain here and be put into condition for the Venice Grand Prix, March 17.

It is almost certain that there will be more than thirty cars entered at San Francisco. The third Duesenberg has been repaired and it has been announced here that Jack Callaghan will have the car in the San Francisco races.

With the announcement that Harry Grant has been signed by the Maxwell interests, comes the news that another Maxwell is to be entered as a special of some kind with Grant up.

Bob Burman returned to the coast yesterday and is still considered a likely entrant. Ralph De Palma reached Los Angeles today, and while he refused to commit himself, it is claimed by close



Start of Glendale road race staged by the Glendale lodge of Elks

friends that he returned to the Pacific Coast to compete in the Vanderbilt event and that also means that he is to be figured in the Grand Prix, barring accidents.

The number entered for the Vanderbilt Cup and Grand Prix events has reached twenty-seven, according to the official list given out today by W. L. Hughson, chairman of the exposition racing committee:

Car	Driver	Entrant
Stutz	Gil Anderson	Stutz Motor Car Co.
Stutz	Earl Cooper	Earl Cooper.
Stutz	Howard Wilcox	Stutz Motor Car Co.
Peugeot	Dario Resta	Peugeot Auto Import Co.
Mercer	Glover Ruckstell	Mercer Automobile Co.
Mercer	Eddie Pullen	Mercer Automobile Co.
Mercer	Louis Nikrent	Mercer Automobile Co.
Marmon	A. A. Cadwell	A. A. Cadwell.
Marmon	Wilbur D'Alene	Wilbur D'Alene.
Simplex	Louis Disbrow	Simplex Auto Co.
Chevrolet	Jack Le Cain	Chevrolet Motor Co.
Maxwell	Barney Oldfield	Maxwell Motor Sales Co.
Maxwell	Wm. Carlson, Jr.	Maxwell Motor Sales Co.
Maxwell	E. V. Rickenbacher	Maxwell Motor Sales Co.
Maxwell	Harry Grant	Maxwell Motor Sales Co.
Duesenberg	Tom Alley	F. S. Duesenberg.
Duesenberg	Eddie O'Donnell	F. S. Duesenberg.
Duesenberg	Callaghan	F. S. Duesenberg.
Delage	C. R. Newhouse	W. E. Wilson.
Thais	Jack Gable	Frederick Robinson
King	Klein	Arthur Klein.
Edwards Special	Unannounced	J. Paulding Edwards.
Edwards Special	Unannounced	J. Paulding Edwards.
Californian	Caleb Bragg	George R. Bentel.
Bugatti	J. B. Marquis	J. B. Marquis.
Parsons Special	Jim Parsons	Jim Parsons.
Gordon Special	Unannounced	Huntly Gordon.

Resta to Drive for Peugeot

NEW YORK CITY, Feb. 6—Dario Resta, the racing driver, has signed a contract with the Peugeot Auto Import Co., of this city, to drive Peugeot cars in the Vanderbilt, Grand Prize and Indianapolis races this year. In the races on the coast Resta will probably drive a car with 100 millimeter bore and 180 millimeter stroke, in inches 3.93 by 7.08 giving a piston displacement of 341 cubic inches. For the Indianapolis 500-mile race he will use a car of the type driven by Duray, who finished second in this race last year. This has a motor 78 by 156 millimeters, or 3.07 by 6.14 inches, giving a piston displacement of 174 cubic inches. Both machines will be four-cylinder types. The Peugeot company will probably have two cars in the Indianapolis race.

Brooklyn to Hold Show March 2-9

BROOKLYN, N. Y., Feb. 6—The Fourth annual show of the Brooklyn, (N. Y.) Motor Vehicle Dealers' Assn. is to be held March 2-9 in the 23d Regiment Armory. It is under the management of Chas. A. Stewart, Hotel Woodward, New York.

Lewis Brings Out Eight at $985

DETROIT, MICH., Feb. 6—Believing this to be an eight-cylinder year, the Lewis Spring & Axle Co., Jackson, Mich., has just announced an eight-cylinder five-passenger car to sell at the record low figure for this type of machine of $985, equipped. The car is known as the Hollier eight, and special emphasis is placed upon the fact that it is not assembled but is manufactured complete in the Lewis factory.

Equipped with a 3 by 4 1-4 V-type motor with the two blocks of four cylinders set at 90 degrees to each other on an aluminum crankcase, the motor, in its general design, adheres to the recognized practice for engines of this class. Suspension is at three points. Specifications of the chassis include a cone clutch of 12-inch nominal diameter, three-speed gearset, combination motor-generator for cranking and lighting which is attached to the gearbox, floating rear axle with annular bearings, 40-inch cantilever rear springs, 112-inch wheelbase, standard tread (60-inch optional), and 32 by 3 1-2 tires on demountable rims. The equipment is in accordance with present-day requirements.

The Lewis concern has been working on this car for about 8 months, but has kept the fact a profound secret until the present time. Active manufacture and distribution of the Hollier is to begin at once, the company expecting to turn out 3,000 in the next year.

Jones Six Appears in Wichita

WICHITA, KAN., Feb. 6—A new car announced here is the Jones six, made by the Jones Motor Car Co. The car is assembled from standard parts and the location of the factory in the heart of the Middle West is believed to provide advantages from a market viewpoint that would not be present if manufacturing were to be carried on further east. Advantages in the way of freight charges are urged for consumers in that territory as it is held that the knockdown parts can be brought to the West at a lower shipping cost than could the completed car.

The new car appears as a five passenger, six-cylinder touring car of 118-inch wheelbase at $1,150. The motor is built by the Lycoming Foundry & Machine Co., and has T-head cylinders, 3 3-8 by 4 3-8, three-bearing crankshaft, thermo-syphon cooling, Remy distributer ignition, combination splash and pressure oiling and Stromberg carbureter with vacuum fuel feed.

The clutch is a steel cone that provides its own spring action. The gearset is a four-speed selective type bolted directly to the motor, which is a part of the unit power plant. Final drive is through a single universal, inclosed in a torque tube. The drive taken through three-quarter elliptic springs, tires are 34 by 5, and equipment includes demountable rims with a spare on the rear. Body lines are smooth, and running boards unencumbered. Starting and lighting is provided by a Leece-Neville system, and such features as one-man top, electric horn, and so on, are supplied. The steering gear is the Warner worm and gear design, and the radiator is a compromise between the V-shape and the flat style.

Panorama showing west end of Vanderbilt and Grand Prize course at Panama-Pacific International Exhibition. Considerable progress has been made since the photograph was taken

Factory Miscellany

MOSLER Purchases Hodgman Plant—A. R. Mosler & Co., New York City, has purchased the large plant occupied formerly by the Hodgman Rubber Works, New York City. This addition measures 273 feet long and four stories high. The screw machine department will be set in the basement, while the next floor will be the stock room, tool room, shipping and receiving department. The next floor will be the offices and assembly department of spark plugs, and the top floor will also be assembly department and stock room. The company does not expect to be moved until some time in April or May.

Motokart's $50,000 Factory—Bids are being received for the construction of a 60 by 300-foot factory for the Motokart Co., Scranton, Pa., the estimated cost being $50,000.

To Enlarge Chandler Plant—The Chandler Motor Car Co., Cleveland, O., will begin construction of an addition to the present plant at once. The addition will be of brick, steel and concrete.

Neighbors Mfg. Electrical Specialties—Electrical specialties used in the automobile industry are to be built by R. C. Neighbors, formerly sales manager of the Hupp Motor Car Co. His headquarters will be at 100 Beaubien street, Detroit, Mich.

To Manufacture Magneto Parts—A. S. Hecht, doing business as Hecht's Magneto Exchange, New York City, has formed the Magneto Parts Co., Inc., to manufacture and distribute parts for all standard magnetos. Associated with Hecht is E. M. Lowe, secretary-treasurer of the new company.

Allis-Chalmers Adds—The Allis-Chalmers Mfg. Co., Milwaukee, Wis., is erecting a large addition at its main works in West Allis, Milwaukee County, to accommodate the transformer department, moved from the Bullock Works in Norwood, Cincinnati, O., to make room for the recently established electric starter-lighting system department.

To Mfr. Metal Specialties—G. N. Prentiss, an inventor, of Racine, Wis., is organizing a $25,000 corporation with the assistance of the Grand Rapids Merchants & Manufacturers' Assn., Grand Rapids, Wis., to manufacture a line of metal specialties, including a compact cook stove for motorists, gasoline and oil gauges, auxiliary seats and a number of light farm implements.

Grant Leases Buildings—The Grant Motor Co., Findlay, O., has leased the buildings formerly occupied by the Findlay Table Co., which will give them about 40,000 square feet of additional room. Automobiles will be finished at this place. It will also be the shipping point of the factory product. In a few weeks the company will begin to turn out fifty of its new sixes per day. A trainload will be sent to California.

To Mfr. Trucks and Automobiles—The Hub Motor Truck Co., Columbus, O., has been incorporated with a capital of $300,000 to manufacture and sell all kinds of automobiles. It is planned by the organizers to open a factory in Columbus for the manufacture of the Hub Motor trucks, basic patents for which are held by the Hub Motor Truck Co. of America, a New York corporation. The incorporators of the Columbus company are T. C. Haney, J. L. Herpich, J. B. Bass, R. Wilke and J. J. Chester. A truck is now being built by the Kaiser Motor Car Co.

The Automobile Calendar

Feb.	Portland, Ore., Show; Portland Auto Trade Assn.
Feb.	Battle Creek, Mich., Show, Rathbun & Kraft Bldg.
Feb.	Toledo, O., Show, Toledo Auto Show Co.
Feb. 8-13	Salem, Mass., Show, North Street Skating Rink, C. O'Shea.
Feb. 8-13	Toledo, O., Show, Terminal Bldg., Toledo Auto Shows Co., H. W. Blevins.
Feb. 8-14	Kansas City, Mo., Show.
Feb. 8-14	Troy, N. Y., Show, Troy Auto. Dealers' Assn.
Feb. 8-15	Wilmington, Del., Show, Hotel duPont.
Feb. 9-12	Eau Claire, Wis., Eau Claire Auto Dealers' Assn.
Feb. 9-12	Peoria, Ill., Show, Peoria Auto & Motor Cycle Dealers.
Feb. 10-13	Davenport, Ia., Show.
Feb. 15	Fort Wayne, Ind., Show, Fort Wayne Auto Trade Assn.
Feb. 15	Tacoma, Wash., Show, Glide Rink.
Feb. 15-20	Grand Rapids, Mich., Show, Klingman Furniture Exposition Bldg., Grand Rapids *Herald*; C. L. Merriman.
Feb. 15-20	Omaha, Neb., Show, Auditorium, C. G. Powell
Feb. 15-20	Bridgeport, Conn., Show, State Armory; B. B. Sterber.
Feb. 16-18	Bloomington, Ill., Show, Deere Bldg.
Feb. 17-20	York, Pa., Show, Coliseum.
Feb. 18-20	Racine, Wis., Show, Lakeside Auditorium, Racine Auto Show Assn.
Feb. 22	Newark, N. J., Light Car Club of N. J., Hillclimb at Teaneck.
Feb. 22	San Francisco, Cal., Vanderbilt Cup Race, Panama-Pacific Exposition Grounds; Promoter, Panama - Pacific Exposition Co.
Feb. 22-25	Allentown, Pa., Show.
Feb. 22-27	Duluth, Minn., Show, Auditorium.
Feb. 22-27	New Haven, Conn., Show, Second Regiment Armory; W. N. Lindsay.
Feb. 22-28	South Bethlehem, Pa., Show, Coliseum; J. L. Elliott.
Feb. 23-27	York, Pa., Show, Coliseum Hall.
Feb. 23-27	Syracuse, N. Y., Show, Armory, Syracuse Auto Dealers' Assn.; H. T. Gardner, Mgr.
Feb. 23-27	Ft. Dodge, Ia., Show, Armory, C. W. Tremain, Sec.
Feb. 24-27	Freeport, Ill., Show, Freeport Automobile Show Co.
Feb. 25	New York City, S. A. E., Metropolitan Sec. Meeting; Report of Research Committee on Kerosene Carbureters. Research Com. Report on Non-Electric Continuous-Torque Transmission.
Feb. 27	San Francisco, Cal., Panama-Pacific Exposition, Grand Prize Race, Panama - Pacific Exposition Grounds; Promoter, Panama-Pacific Exposition Co.
Mar. 1-5	Wilkesbarre, Pa., Show. Vehicle Trades Assn.
Mar.	Benton Harbor, Mich., Show, St. Joseph and Benton Harbor, St. Joseph Garage, St. Joseph.
Mar.	Charlotte, Mich., Show.
Mar. 2-9	Brooklyn, N. Y., Show, Motor Dealers' Assn., 23rd Regiment Armory.
Mar 3	Albany, N. Y., Associated Garages of America, General Convention.
Mar. 3-4-5-6	St. Joseph, Mich., Show, St. Joseph Auto Co. Bldg.
Mar. 4-6	Springfield, Mass., Show; J. H. Graham.
Mar. 6-13	Boston, Mass., Show, Mechanics Bldg., Boston Auto Dealers Assn., Boston Commercial Motor Veh. Assn.
Mar. 6-13	New York City, Made in the U. S. A. Exhibition, Grand Central Palace.
Mar. 8-13	Indianapolis, Ind., Annual Spring Opening, Indianapolis Auto Trade Assn.
Mar. 8-13	Canton, O., Show, Auditorium, Stark Co. Auto Show and Electrical Exposition.
Mar. 8-13	Des Moines, Ia., Show, C. G. Van Vliet.
Mar. 8-13	Utica, N. Y., Utica Automobile Trade Assn.
Mar. 13-20	Harrisburg, Pa., Show Arena, Harrisburg Dealers' Assn.
Mar. 14	San Francisco, Cal., Panama - Pacific Cup Race, Panama - Pacific Exposition Grounds; Promoter, Panama - Pacific Exposition Co.
Mar. 17	Venice, Cal., Cal. Grand Prix, 300-Mile Road Race.
Mar. 22-27	Bangor, Me., Show, Bangor Auditorium.
April	Calumet, Mich., Show, Coliseum.
April 3	Paterson, N. J., Show, Auditorium, R. A. Mitchell.
Apr. 16	Manchester, Eng., Show, Ice Palace, North of England Motor Shows, Ltd.
May 17-18	Boston, Mass., A. A. A. Annual Meeting.
May 29	Indianapolis, Ind., 500-Mile Race, Indianapolis Motor Speedway.
June 9	Galesburg, Ill., Two-mile Track Meet.
June 19	Chicago, Ill., 500 - Mile Race, Chicago Speedway.
June 25	Sioux City, Ia., Track Meet.
July 4-5	Tacoma, Wash., Road Race.
Aug.	Milwaukee, Wis., Independent Petroleum Marketers' Assn. of the U. S.; 1915 Convention in Milwaukee.
Aug. 2-3	San Francisco, Cal., Tri-State Good Roads Assn., Third Annual Convention.
Aug. 20-21	Elgin, Ill., Road Race.
Sept. 20-25	San Francisco, Cal., International Engineering Congress.

The Week in the Industry

Motor Men in New Roles

SPENCER Resigns from Autocar—C. H. Spencer has tendered his resignation as advertising manager of the Autocar Co., Ardmore, Pa., having been with that concern for about 6 years' time. He will undertake a program of work which will include writing on the subject of motor trucks and the opening of an advertising service office in the Land Title Bldg. of Philadelphia.

Williams Goodyear Mgr.—C. H. Williams is manager of the Portland (Ore.) branch of the Goodyear Tire & Rubber Co.

Hunt Dunlop's Montreal Mgr.—M. J. Hunt has been appointed manager of the Montreal (Que.) branch of the Dunlop Tire Co.

Shick Cleveland Goodyear Mgr.—E. G. Shick has been appointed manager of the Cleveland (O.) Goodyear tire branch, succeeding L. L. First.

Derrickson McQuay-Norris Rep.—C. L. Derrickson has been appointed general representative of the McQuay-Norris Mfg. Co., St. Louis, Mo.

Beall Promoted—F. F. Beall, who has been factory manager of the Packard Motor Car Co., Detroit, Mich., has been promoted vice-president in charge of manufacturing.

Williams Succeeds Hartman—W. S. Williams has been appointed manager of the Dallas (Tex.) branch of the Studebaker Corp. in place of C. W. Hartman, who has resigned.

Wright Mgr.—F. J. Wright, formerly with the Wright Motor Car Co., Memphis, Tenn., has taken the management of the electric department of the H. A. White Auto Co., that city.

Findeisen Sales Mgr.—C. W. Findeisen has been appointed general sales manager of Findeisen & Kropf, Chicago, Ill. For the last 4 years he has been in active charge of the factory sales.

Gilbert Mgr.—The Oregon Motor Car Co. has secured the services of Steve Gilbert as manager of the commercial car department, agent for the Signal line of trucks for Portland, Ore., and vicinity.

Splitdorf Man Gets New Post—E. A. Kelley, long branch manager in Chicago, Ill., for the Splitdorf Electrical Co., has been transferred to Detroit, where he will be the special representative for the Apple Electric Co.

Anderson Dayton Rubber Mgr.—W. E. Anderson has been appointed district manager of the Dayton Rubber Mfg. Co., Dayton, O. His headquarters are 2011 Michigan avenue, Chicago, the new branch in that city.

Girard Joins Reo Agency—F. J. Girard, formerly manager of the Columbus (O.) branch of the Peerless Motor Car Co., has resigned and become financially interested in the Capital Motor Car Co., Columbus agent for the Reo.

Wildhack Oldsmobile Agent—G. O. Wildhack, formerly manager of the Indianapolis (Ind.) branch of the Oakland Motor Car Co., is now owner of the Wildhack Co., which has secured the agency for the Oldsmobile cars.

Morton Sails for London—R. L. Morton, of the Morton Truck & Tractor Co., Harrisburg, Pa., sailed February 3 on the liner "Adriatic" for London, England, where he will represent his company in securing contracts for the allied armies.

Marks N. Y. Olds Mgr.—S. A. Marks, Jr., has been appointed manager of the Oldsmobile Co., of New York. He will assume his new duties immediately upon the opening of the new salesrooms of the company at 1800 Broadway, New York City.

Seidel Succeeds Hill—G. E. Seidel, president of the Pilot Motor Car Co., Richmond, Ind., has succeeded to the duties of treasurer and general manager formerly performed by T. H. Hill, who has severed his connection with the company.

Winsor and Clarke Mgrs. Detroit Office—S. A. Winsor and W. J. Clarke are managers of the offices which have been opened at 965 Woodward avenue, Detroit, Mich., by the Spencer Smith Machine Co., manufacturer of automobile pistons in Howell, Mich.

Adds to Sales Staff—The Dimond-Apperson Motor Co., New York City, distributer of the Apperson car, has engaged T. F. Skelly to look after its wholesale business. Mr. Skelly has been with the Apperson company at Des Moines, Ia., for the last 5 years.

Nadjer Cotta's Detroit Representative—The Cotta Transmission Co., Rockford, Ill., manufacturers of automobile transmissions, has appointed K. W. Nadjer, a consulting automobile engineer, as its Detroit representative. He will have his offices in the Chamber of Commerce Building.

Grant in New Rôle—G. B. Grant, until recently superintendent of agencies of the Oakland Motor Co., has become a member of the Pittsburgh Apperson Co., Pittsburgh, Pa., and will have supervision and appoint agents in western Pennsylvania, eastern Ohio, western Virginia and part of western Maryland.

Veal Joins Saxon Agency—S. H. Veal, formerly secretary and general manager of the Cleveland Motor Car Co., and late secretary of the Colt-Stratton Co., Eastern distributors for Cole, has joined the forces of the Saxon Motor Car Co. as traveling representative for New Jersey, with headquarters at 278 Halsey street, Newark, N. J., where the Essex County agency and the New Jersey service station of the Saxon will be located.

Nelson Organizes New Co.—G. V. Nelson, former advertiisng manager and second vice-president of the Auto Parts Co., Chicago, Ill., will organize a new company along the same lines in Kansas City, Mo., to be known as the K. C. Auto Parts Co., of which he will be president and general manager. This new concern will occupy a two-story and basement building at 1827 McGee street, where a complete line of automobile accessories and parts will be carried.

Garage and Dealers' Field

Chandler Adopts New Sales Plan—The increasing business has made it necessary for the Chandler Motor Car Co., Cleveland, O., to add more men to its sales department force. The sales territory has been divided into two sections, each with an assistant sales manager at its head. W. G. Clay has been appointed in charge of the Eastern district and Sid Black in charge of the central district. F. G. W. Sudrow, formerly sales manager of the Marion Motor Car Co., and Benjamin Rennard have been appointed special factory representatives of the company.

J. I. C.'s New Innovation—The J. I. Case T. M. Co., Racine, Wis., manufacturer of farm implements and machinery and motor vehicles, has made an innovation by establishing a wholesale and retail store, service station and display room for all products near the downtown works in Racine. Recently the Case company took over the plant of the former Fish Bros. Wagon Co., Racine, and has remodeled the first floor of the State street frontage into a store where all Case products, from threshing machines to motor cars, will be exhibited and sold. The station is in charge of A. J. Kellam, who has been for 3 years manager of the Case automobile branch at Little Rock, Ark.

Philadelphia Cos. Move—The Overland Motor Co. has removed from 132 North Broad street, Philadelphia, Pa., to the northeast corner of Broad and Wood streets. The former home of the Bergdoll Taxicab Co., in the rear, has also been added to the new quarters, giving the company approximately 55,000 square feet of floor space in its new location. Harry Greenwood is the general manager and treasurer; R. P. Greenwood, sales manager, and Judson Sprankle, president of the company. The Johnson Motor Car Co., distributer of the Haynes and Saxon cars, has vacated 326 North Broad street and removed to the new sales and service building, 132-134 North Broad street.

Big Oakland Deal in Cleveland—One of the largest deals consummated in Cleveland automobile circles in recent years is that concluded by the Oakland Motor Co., in transferring the business of the Cleveland and Pittsburgh branches to a new local organization to be known as the Adams-Oakland Co., with H. M. Adams as vice-president and general manager. The transaction involves approximately one-half million dollars, automobile men are given to understand, and includes the territory of both branches, nearly all of the counties in Pennsylvania and Ohio. H. M. Adams has for years been connected with the White and Peerless companies. Fred C. Wood, formerly branch manager, though no longer directly connected with the new organization, does not sever his connection with the parent concern. Salesrooms will continue at Euclid avenue and East Nineteenth street, Cleveland. Mr. Adams has already assumed office in charge of the branches.

Automobile Agencies Recently Established

PASSENGER CARS

Connecticut

Hartford	Monarch	Hartford Garage Co.
Hartford	Moon	Kingsbury & Wetherall
Hartford	Allen	J. M. McDonald Co.
Hartford	Dodge Bros.	Charter Oak Motor Car Co.
Hartford	Hupmobile	Charter Oak Motor Car Co.
New Britain	Dodge Bros.	W. J. Morrin
New Britain	Briscoe	W. J. Morrin
Stamford	Moon	H. Hendrie
Wethersfield	Allen	J. M. McDonald Co.

District Columbia

Washington	Hupmobile	Burger Motor Co.
Washington	Jeffery	Combs-Howard

Florida

Jacksonville	Dodge Bros.	Sinkler Auto. Co.

Georgia

Atlanta	Saxon	G. W. Hanson

Idaho

Twin Falls	Moon	Smith & Spafford

Illinois

Aurora	Regal	W. S. Miller
Bloomington	Haynes	Dan Sullivan
Bloomington	Regal	L. I. Gilmore
Casey	Westcott	Westcott Motor Sales Co.
Chadwick	Regal	George Etnyre
Champaign	Herff-Brooks	E. E. Burton
Chicago	Detroiter	The Farrington Motor Co.
Fairbury	Regal	H. M. Sutton
Hamilton	Regal	F. C. Kopsicker
Homer	Regal	J. G. Davidson
Huntley	Regal	F. A. Weltzien
Joliet	Regal	Joliet Motor Co.
Kankakee	Regal	E. A. Jeffers
Lacon	Haynes	J. R. Balsley & Son
Long Creek	Regal	Hayden Veatch
Mazon	Regal	T. E. Kelly
Mendota	Oldsmobile	A. J. Austin
Monmouth	Regal	C. M. Barnum
Peru	Regal	Brunner Fdry. & Mch. Co.
Quincy	Moon	J. W. Meyer & Son
Shermerville	Regal	E. Landwehr
Smithshire	Regal	F. R. Gunn
Sycamore	Regal	James Shaw
Tolono	Haynes	Guy E. Duell
Tremont	Regal	E. E. O'Brien
Wenona	Oldsmobile	Robinson Motor Car Co.
Woodhull	Regal	Union Sales Co.

Indiana

Delphi	Haynes	R. C. Julien
Ft. Wayne	Westcott	D. H. Harris
Greensburg	Haynes	H. P. Overleese
Hartford City	Westcott	A. W. Tindall
Indianapolis	Monarch	E. M. Holmes
Indianapolis	Stutz	Conduit Automobile Co.
Marion	Saxon	H. V. Smith
Sullivan	Haynes	E. E. Russell
Terre Haute	Haynes	J. G. Matheny
Wabash	Oldsmobile	J. W. Bloomer

Iowa

Ainsworth	Oldsmobile	Marr Hdwe. Co.
Bennett	Oldsmobile	Harding & Trotter
Bode	Regal	Kenseth & Ries
Buffalo Center	Glide	Clark Brothers
Burlington	Regal	Sheagren Hunt Co.
Clear Lake	Oldsmobile	Scott & Leonard Auto Co.
Creston	Regal	J. F. Russell
Davenport	Oldsmobile	C. F. Zoeckler
Eagle Grove	Regal	Wm. Fletcher
Fort Dodge	Chandler	Hanson & Tyler
Granger	Oldsmobile	Fred L. Anderson
Grinnell	Glide	J. E. Alexander
Grundy Center	Oldsmobile	A. C. Shafer
Hastings	Haynes	Sandiland & Parker
Hudson	Oldsmobile	Ray McDowell
Lake Park	Franklin	H. C. Meyer
Lanyon	Kissel	G. T. Peterson
LeMars	Glide	Ernsterhoff Auto Co.
Marshalltown and Eldora	Regal	H. W. Emeny Auto Co.
Mason City	Moon	Harris Auto. Co.
Merango	Haynes	Jos. Mulhern
Mt. Pleasant	Moon	V. E. Bellinger
Minburn	Regal	S. D. A. Guernsey
Moville	Haynes	E. E. Fiegan
Nevada	Haynes	Central Iowa Garage
New Providence	Haynes	W. L. Thornton
Newton	Oldsmobile	C. S. Weston & Co.
Newton	Regal	Woody Auto Co.
Osceola	Herff-Brooks	Keeran & Collins
Perry	Haynes	Wilson Auto Co.
Redfield	Haynes	Redfield Auto Supply Co.
Sabula	Herff-Brooks	E. L. Smith
Sioux City	Haynes	Wyckoff Auto & Supply Co.
Story City	Oldsmobile	Story City Auto Co.
Tiffin	Herff-Brooks	August Amish
Tripoli	Oldsmobile	Arneman Auto Co.
Van Meter	Oldsmobile	England Auto Co.
Villisca	Haynes	H. C. Evans
Vinton	Haynes	O. C. Prescott
Washington	Oldsmobile	Donaldson & Benn
Wilton	Herff-Brooks	F. Schweitzbreger & Son
Yale	Regal	N. M. Caple

Kentucky

Campbellsville	Studebaker	Buchanan-Lyons Co.
Elizabethtown	Studebaker	A. H. Douglas
Glasgow	Studebaker	Glasgow Motor Car Co.
Hodgensville	Studebaker	D. G. Hays
Lebanon	Studebaker	T. M. Estes
Lexington	Haynes	Commercial Auto Co.
Louisville	Maxwell	Monarch Auto Co.
Louisville	Ohio Electric	Electric Garage Co.
Louisville	Milburn Electric	Electric Garage Co.
Louisville	Allen	Kenton Motors Co.
Louisville	Lewis	Kenton Motors Co.
Louisville	Detroiter	Co-operative Motor Car Co.
Munfordsville	Studebaker	C. A. Dawson
Pleasureville	Studebaker	Riner & Wood
Shelbyville	Studebaker	E. R. Wilson
Springfield	Studebaker	McClure & Mays

Kansas

Cawker City	Oldsmobile	J. F. Meyer
Great Bend	Moon	Great Bend Hdwe. & Imp. Co.
Hutchinson	Haynes	Painter & Oliphant
Kingman	Studebaker	Grant & Oakes
Kingman	Overland	Grant & Oakes
Larned	Haynes	H. T. Taylor & Son
Liberal	Moon	W. G. Woods
Macksville	Oldsmobile	R. W. Welch
Rexford	Moon	Fred Masher & Sons
Russell	Chandler	H. A. Fink
Salina	Haynes	C. W. Tibley
Scranton	Moon	Sappenfield & Co.
Topeka	Chandler	Independence Auto Co.
Topeka	Oldsmobile	Kansas Motor Car Co.
Wichita	Moon	H. W. Schroeder

Massachusetts

Boston	Detroiter	Reed-Crockett Co.
Boston	Briggs-Detroiter	Reed-Crockett Co.
Boston	Crow	A. P. Sackley
Boston	Coey	E. P. Blake
Brockton	Westcott	Marble Auto Co.
Brockton	Buick	White Auto Co.
Concord	Ford	Torrey & Vialle
Haverhill	Paige	Hayden Brown
Haverhill	Studebaker	Ellison Motor Supply Co.
Lynn	Reo	John J. Hun
Malden	Haynes	Malden Center Garage
Millers Falls	Oldsmobile	A. H. Sawyer
New Bedford	Kissel	B. A. Vance
North Adams	Ford	Van Sleet Motor Co.
Somerville	Ford	Hill-Michie Co.
Worcester	Paige	J. V. Ekberg
Worcester	Hupmobile	J. W. Grady Co.

Maine

Augusta	Oldsmobile	Fiffield Bros. Co.
Bangor	Oldsmobile	A. L. Towle
Caribou	Oldsmobile	W. L. Collins
Lake View	Oldsmobile	A. E. Rosie
Oakland	Oldsmobile	C. R. Blaisdell
Port Fairfield	Chandler	Bishop & Doran
Portland	Studebaker	Studebaker Corp.
Portland	Chandler	Leighton, Durrah & Griffin
Portland	Oldsmobile	D. E. McCann
Saco	Chandler	H. A. Harris

Michigan

Adrian	Ford	Johnson & Mitchell
Allegan	Dodge Bros.	W. W. Vosburgh
Azalia	Haynes	A. J. Howe
Battle Creek	Haynes	L. S. Knowles
Bellevue	Ford	F. Clark
Charlotte	Ford	Barber Brothers
Charlotte	Overland	Barber Brothers
Grand Rapids	Franklin	Security Auto Sales Co.
Grand Rapids	Saxon	Grand Rapids Saxon Co.
Grand Rapids	Metz	Metz Garage
Greenville	Dodge	John & M. Christensen
Holland	Studebaker	M. Barnum
Kalamazoo	King	W. O. Harlow
Ionia	Monroe	R. H. Van Vleck
Ionia	Hudson	Eugene Kerstetter
Ionia	Studebaker	Eugene Kerstetter
Ionia	Oldsmobile	Eugene Kerstetter
Ishpeming	Overland	E. R. Nelson
Lainsburg	Oldsmobile	E. E. Leland
Lebanon	Franklin	N. A. Meyers
Lebanon	Studebaker	N. A. Meyers
Lebanon	Chalmers	N. A. Meyers
Ludington	Haynes	J. H. Cornelly
Monroe	Reo	C. A. O'Lone
Mt. Pleasant	Ford	F. H. Johnson
Mt. Pleasant	Ford	O. L. Kigar
Mt. Pleasant	Dodge	Standard Garage
Muir	Paige	Sykes & Dilley
Ovid	Ford	G. F. Smith
Port Huron	Maxwell	Wm. Varkell
Sandusky	Dodge Bros.	Woolman & Ferguson
St. Johns	Maxwell	The Moss Garage
St. Johns	Studebaker	The Moss Garage
St. Johns	Ford	G. F. Smith & Son
Sheboygan	Studebaker	Sheboygan Auto Sales Co.

Minnesota

Marshall	Haynes	M. F. Thomas
Minneapolis	Remington	G. L. Moore

Missouri

Green City	Oldsmobile	J. D. Bohrer
Glasgow	Oldsmobile	E. Ballew
Kansas City	Pullman	I. D. McGrew
Kansas City	Cole	Myers-Ebersole
Kansas City	Westcott	Kansas City Auburn Auto Co.
Kansas City	Velie	Velie-Thorp Motor Co.
Kansas City	Pullman	I. D. McGrew
King City	Haynes	Leith & Croon
St. Joseph	Chandler	Leslie Motor Car Co.
St. Louis	Kissel	Colonial Motor Car Co.
St. Louis	Milburn	Cartwright Motor Car Co.
St. Louis	Pullman	Ideal Motor Co.
St. Louis	Cole	Cole-Arbogast Auto Co.
St. Louis	Metz	Deluxe Automobile Co.
Washington	Moon	C. A. Krumsick

Montana

Helena	Oldsmobile	T. C. Power Co.
Missoula	Oldsmobile	Tumulla & Bleier Auto Co.
Sidney	Oldsmobile	J. A. Barrett

Nebraska

Omaha	Paige	Murphy-O'Brien Co.
Palmer	Haynes	John Kruse

Nevada

Tonopah	Oldsmobile	H. H. Bacon

New Hampshire

Conway	Haynes	W. F. Chapman
Wilton	Oldsmobile	F. W. Clark

New Jersey

Bloomfield	Regal	Central Motor Car Co
Closter	Regal	Costner & Brown
Elizabeth	Regal	Elizabeth Auto Co.
Red Bank	Kissel	E. von Kattengell
Summit	Oldsmobile	F. A. Wahl
Washington	Regal	Eckle's Garage

New Mexico

Albuquerque	Glide	F. F. Trotter
Deming	Chandler	Case & McKinley

New York

Binghamton	Moon	S. & O. Motor Co.
Bloomingburg	Kissel	Clapman & Hagan
Brooklyn	Regal	Woods Garage & Sales Co.
Brushton	Regal	B. F. Harris
Buffalo	Kissel	B. F. Milson
Buffalo	Saxon	Poppenburg Motor Car Co.
Buffalo	Moon	Hurd-Landschaft Motor Car Co.
Clifton Springs	Franklin	C. L. Bailey
Dundee	Haynes	Earnest & Co.
Elmira	Franklin	F. M. Jones
Hurleyville	Haynes	W. J. Prince & Son
Ithaca	Haynes	J. P. Lang Engine & Garage Co.
Ithaca	Oldsmobile	E. J. Trapp
Kingston	Moon	Stryker & Youmans
Maugatuck	Regal	L. A. Dibble
New York	Enger	Mutual Motor Sales Co.
New York	Regal	Webster-Macgowan, Inc.
New York	Herff-Brooks	Diamond-Warren Motor Co.
Potsdam	Oldsmobile	G. P. Lyman
Rochester	Moon	W. M. Kipp
Rome	Oldsmobile	R. C. Laigai
Schenectady	Regal	Mabey & Maloney
Schenectady	Hudson	Stratton-Rose Co.
Schenectady	Oldsmobile	C. C. Kenoe
Troy	Hudson	Listman-Stratton Co
Walden	Regal	J. R. Walker
Watkins	Haynes	Watkins Garage
Waverly	Moon	State Line Motor Co.

North Dakota

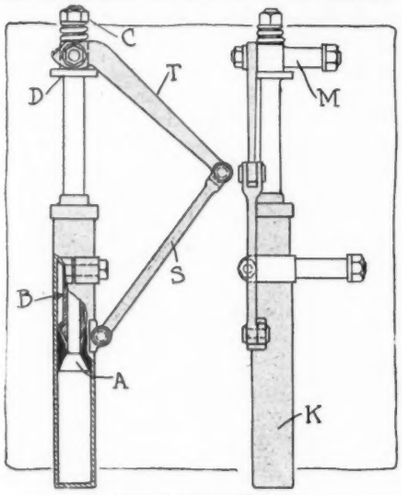
Bowbells	Oldsmobile	Heath & Drinkwater
Clio	Haynes	F. G. Covington Auto Co.
Dickinson	Franklin	Dickinson Motor Car Co
Fargo	Studebaker	King & Dahl

Ohio

Ada	Franklin	Stemple & Smith
Akron	Haynes	J. J. Stickles
Ashtabula	Oldsmobile	Windermere-Euclid Garage Co.
Athens	Regal	J. S. McCarter
Bowling Green	Westcott	C. C. Richardson
Bucyrus	Empire	S. Hirtz & J. M. Smith
Bucyrus	Ford	A. L. Holloway
Camden	Regal	Crauder & Pugh
Canton	Haynes	The Canton Haynes Co.
Canton	Overland	Canton Motor Car Co.
Carey	Oldsmobile	Black & Black
Christiansburg	Regal	Bright & Neal
Cincinnati	Briscoe	Citizens Motor Car Co.
Cincinnati	Maxwell	The Kruse Motor Car Co.
Cincinnati	Reo	Herold Motor Car Co.
Cincinnati	Grant	Eureka Auto Co.
Cincinnati	Princess	Hunter-Dammel Co.
Cincinnati	Franklin	The Franklin Motor Car Co.
Cincinnati	Allen	Kenton Motors Co.
Cincinnati	Lewis	Kenton Motors Co.
Cincinnati	Studebaker	The Imperial Motor Car Co.
Cincinnati	Pullman	Pullman Motor Car Co.
Circleville	Hupmobile	G. L. Schiear
Circleville	Cadillac	G. L. Schiear
Circleville	Oldsmobile	Noecker & Brehmen
Cleveland	Princess	Albaugh Motor Sales Co
Cleveland	Chalmers	J. H. Greenwald
Cleveland	Allen	Stark Auto Co., Inc.
Cleveland	Oakland	Oakland Motor Co.
Cleveland	Oldsmobile	Windemere-Euclid
Cleveland	Pullman	M. D. Coate
Cleveland	Detroiter	M. D. Coate
Cleveland	Studebaker	A. R. Davis
Cleveland	Allen	The Stark Motor Car Co.
Cleveland	Kisselkar	Brandt Motor Car Co.
Cleveland	Hupmobile	The Cleveland Motor Sales Co.
Columbus	Milburn Electric	The Standard Motor Car Co.
Columbus	Jeffery	Capital Motor Car Co.
Columbus	Monarch	Monarch Motor Sales Co.
Columbus	Kissel	C. G. McCune
Columbus	Argo	Auto Inn & Exchange
Coshocton	Saxon	G. J. Beck & Son
Coshocton	Oldsmobile	E. F. Conrad
Coshocton	Haynes	The Fifth St. Garage

ACCESSORIES

NACO Shock Absorber — Theoretically a shock absorber ought to offer increasing resistance with the increase in movement of the spring to which it is attached. For small deflections the car springs ought to be satisfactory, and the function of the absorber is to resist extra violent motion, by adding to the natural frictional resistance of the leaves of the main spring. One of the most recent attempts to produce a shock absorber that offers growing resistance as deflection increases is



Naco shock absorber

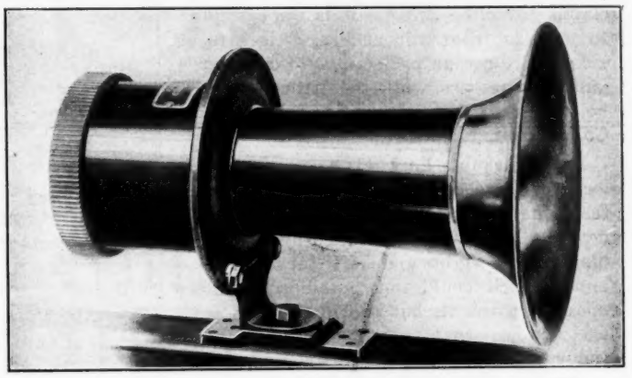
the Naco illustrated here. Not only is the absorber extremely simple, but it should be light in weight and moderately inexpensive to manufacture. It is easy to adjust and any wear that may take place can be compensated for without affecting the range of working to the slightest degree. The friction is supplied by a piston sliding in a cylinder, and the ingenuity of the device lies in the means adopted to vary the amount of friction in accordance with degree of movement. To this end the piston is split in two halves, being cut in two vertically, and it is coned out inside so as to present a bell mouth whichever end is uppermost. A rod with a conical end passes through the piston, shown at A, and there is a tube B, with another conical extremity that rests in the top of the piston. The rod is carried up to the nut C, and the tube ends at the collar D. The cylinder K is attached to the axle and the bracket M to the frame of the car. Deflection of the main spring causes the cylinder to slide up the piston but this lifts the arm S, and since this arm is pinned to the other arm T, the latter is also lifted. Now, the end of T is a cam which lies between the nut C, and the collar D, so that lifting T turns the cam and forces apart C, and D. This separates the upper ends of the tube and the piston rod causing their respective coned ends to be forced nearer together inside the split piston, so expanding it and pressing it hard against the cylinder walls thereby increasing the friction. Adjustment is made by turning nut C, which puts more pressure on the coil spring beneath. — National Appliance Co., Grinnell, Ia.

Positive Steam Tube Vulcanizer — The manufacturers will place on the market shortly an improved portable steam tube vulcanizer, designed exclusively for repairing inner tubes. The new Positive repairs any hole in one operation and makes larger repairs by resetting the vulcanizer. It will repair automobile, bicycle, cyclecar and motorcycle tubes.

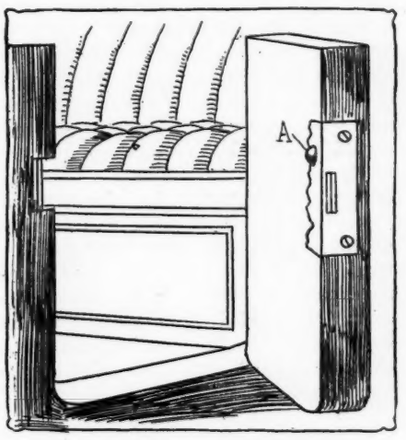
The Positive has a water compartment between the tube and fuel compartments which controls the heat and insures perfect repairs, eliminating all danger of burning, overcuring or undercuring. It is portable, so can be carried in a tool kit of a car. It sets on the running board, fender or bench or can be fastened by means of a wood screw that comes with the outfit to a post wherever convenient. It is automatic in its operation, repairs a tube in 12 minutes' time and extinguishes itself after the work is completed.

The Positive is packed in a neat box with complete vulcanizing outfit consisting of a measuring cup, screw, sand-paper, scissors and enough tube repair stock. Sold under a money back guarantee.—Positive Supply Co., Davenport, Ia.

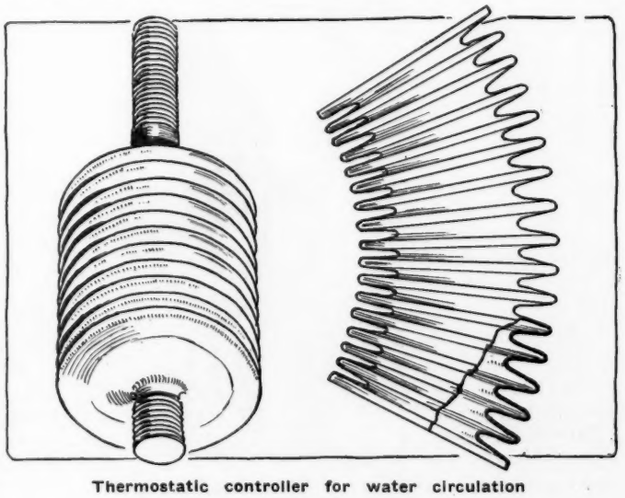
Thermostatic Controller for Water Circulation — The accompanying sketch shows the construction of the expansible part of the water circulation controller employed on the new Cadillac. An ordinary barometer contains a flat box of spring steel which has its top and bottom corrugated in a series of rings, and sealed inside is a small quantity of air that expands or contracts with each change in the atmospheric pressure. This lifts or withdraws the top of the box and so operates the pointer mechanism. The thermostat works on somewhat the same principle, only the action of heat upon a small quantity of sealed air is used to cause the expansion. In order to utilize the expansion of air to control a valve a corrugated box is used, but of a different type to that in the aneroid barometer, as it consists of a copper tube with thin walls on which a number of hollow flanges are raised by a spinning or pressing process. The left view shows the sealed box with its solid ends for attaching to the valve and the right the corrugated tube pulled out to show form.—Fulton Co., Knoxville, Tenn.



Boyce hand horn



Button operated door lock



Thermostatic controller for water circulation

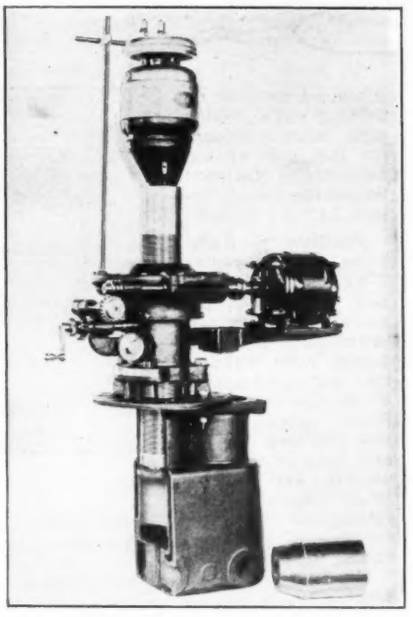
Push-Button Door Lock—The See-Rite is a door latch operated by a push button on the top edge of the door, this being the only part visible when the door is closed. When the thumb or finger presses the button below the level of the top of door, the bolt is withdrawn and the door can be opened. When in the

withdrawn position the bolt is locked back by a small spring plunger shown at A, and when the door is closed again it is the contact of this plunger with the strike plate that releases the bolt. It is stated that only a slight pressure is needed so the door need not be slammed but can be closed quite gently. The device has claims to notice because it is impossible to beat for neat appearance, it is safe, since there are no projections to catch in garments or rugs, while the fitting should be easier than usual.—Searight Mfg. Co., Detroit, Mich.

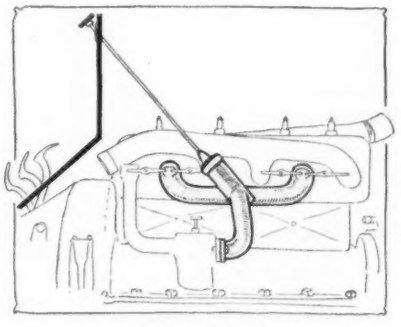
An Unpickable Lock—The Jones Autolock for Ford cars is of a type that defeats the most expert lock picker, since not only is the lock controlled by a combination of right and left turns of a knob, which could not possibly be hit upon by accident, but the mechanism is enclosed so that a whole battery of spanners and cutting tools cannot suffice to free it. The device is supplied made integral with an aluminum manifold of Ford type, to which the carbureter is bolted in the ordinary way, and which is bolted to the cylinders in place of the old manifold. Opening off the manifold is a short passage containing the lock and a plunger which can be dropped across the intake passage so as absolutely to close it. It is only by knowing the lock combination that the plug can be withdrawn, so the only way in which a thief could get away with the car would be to fit a complete new intake manifold. As shown in the sketch, the control is carried up through the dashboard and ends there in a neat, plated thumb nut.—Jones Auto Lock Co., Tacoma, Wash.

Portable Grinder—This is a cylinder grinder intended for repair shop use, being easily set to regrind cylinders of any bore customary in automobile practice. The machine is designed for direct attachment to the cylinder upon which it has to operate and the process is automatic once it has been started. The main frame of the tool that is bolted to the cylinder carries a big bar inside which the grinding wheel spindle revolves, the latter being driven by a one-sixth-horsepower motor. For the feed the main bar is threaded, and is caused to rotate and descend simultaneously by means of a train of worm gearing driven by a second electric motor of one-tenth horsepower. It is stated that the current from a lighting socket is sufficient to operate both motors. Judging by appearance, the tool should find a wide field of use awaiting it.—Boxhill & Bruel, Cincinnati, O.

Twist-of-Wrist Horn — A mechanical warning signal with a new method of operation is shown in the illustration herewith. Instead of providing a handle to be turned, or a button to be pushed down the rear end revolves, and has its periphery knurled so as to afford a grip. It is thus much the same as the rotating handle type, only with a simpler ex-



Portable cylinder grinder



Ford Autolock

terior. It is stated that a movement of so little as 1 inch, circumferentially, is sufficient to produce a loud note and it does not matter in which direction the motion is made.—The Boyce Co., 1790 Broadway, New York City.

New Solar bracket

Swiveling Bracket—A Solar novelty is a swiveling bracket mounting for an electric headlight which can be swung in both a vertical and horizontal direction. As can be seen from the illustration, the device is very neat in appearance and it should also be light in weight. The 1915 Solar catalogue contains descriptions of many different styles of lamps and has also a page or two devoted to the principles of headlight design which make interesting reading.—Badger Brass Mfg. Co., Kenosha, Wis.

Imperial Welding Outfits—The Imperial Brass Mfg. Co. are the manufacturers of a line of oxy-acetylene welding outfits. Five types are offered, four being unmounted and one fitted to a platform truck. All come equipped with suitable torches and a number of special tips, high-pressure hose and clamps, regulators and all the accessories, such as goggles and wrenches. Besides the welding line, the concern is showing oxygen decarbonizers, pressure gauges and regulator valves for all classes of welding.

Catalogs Received

Leather Fittings for all automobile purposes. Magneto boots, straps, cushions, steering gear boots and similar sundries.—W. H. Hoover Co., New Berlin, O.

Gasoline Storage is dealt with fully in the Bowser Bulletin. This describes Bowser outfits for all kinds of garage installations, both inside the building and outside, on the sidewalk.—S. F. Bowser & Co., Fort Wayne, Ind.

Small Fittings such as taps, cocks, hose bands and pump connections. Also lubricators, small gauges, and little tools like punches and small screw drivers, radiator caps, hub caps and brass fittings of various kinds.—E. Edelmann & Co., Chicago, Ill.

Veedol. This is the title of an interesting treatise on lubrication, in which all automobile motor oiling systems are illustrated by a series of diagrams representing sectional motors, and printed in color. The booklet is well produced and contains many useful hints upon car maintenance.—Platt & Washburn Refining Co., New York City.

Trunks are now made in an immense variety of patterns and their manufacturers' catalogs become quite bulky volumes. The 1915 catalog of Ajax trunks is no exception to this rule, and contains a few novelties, notably a large and very completely fitted buffet case. Composite cases containing several individual grips are a feature of the Ajax line.—Ajax Trunk and Sample Case Co., New York City.